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THE ACTUAL COST OF GENERATING THE LIGHT.

One of the questions which is continually exciting the attention of municipal councils and public-service corporations is the relation of the cost of producing the utility to the elements which should be included in estimating that cost. Factors of depreciation, insurance, distribution, etc., have been pretty well threshed out in this and other countries quite recently, and for ourselves at least we have arrived at the conclusion that there is very little of the expense involved in producing a public utility that is not necessarily a part of the cost of producing that utility. In view of this conclusion and of the discussion which the matter still entails, the story of the litigation between the town of Bulawayo, Rhodesia, and the local lighting company, as gleaned from the reports of appeal case No. 241 (Bulawayo versus the Bulawayo Waterworks Company, 1908) by Mr. Alton D. Adams, is of interest.

Bulawayo, Rhodesia, became bound to pay for its street lighting on the basis of "a return equal to ten per cent over the actual cost of generating the light."

Under this contract the company that operated the electric street lamps charged 3.88 pence per unit as the estimated cost of depreciation, also a sum for insurance, besides all other costs of the street-lighting service. Bulawayo objected to charges for depreciation, insurance and electric distribution, as not covered by the expression, "Actual cost of generating the light," and contended that these words meant only the cost of operating the generating plant, not including its depreciation. No question appears to have been raised as to whether 3.88 pence per unit was the correct amount to charge for depreciation.

Judgment went against Bulawayo in the African courts, and the appeal of the municipality was decided by the Privy Council of England.

In giving the judgment of the Privy Council, Lord Macnaghten said, quoting the chief justice of the court below:

"The cost of the plant forms part of the actual cost of generating the light, but, as the use of that plant would extend over several years, it could obviously not have been intended that the whole of that cost shall be charged during the first quarter (of the contract). But the same objection does not exist to a distribution of the actual cost of the plant over the whole period of the life of such plant. The effect of allowing a certain sum for depreciation in the quarterly accounts of the plaintiffs would simply be to distribute the actual cost of the plant over the whole period during which it would, in the ordinary course, be of any service in the generation of electricity and light." The charges for depreciation, as well as those for distribution and insurance, were upheld.

CENTRAL-STATION DEVELOPMENT AND POWER COST.

Whenever figures of power cost are available for a series of years in a station undergoing a gradual evolution in design, it is most instructive to analyze the results progressively, and note, if possible, the effect of changes in equipment and their arrangement upon the economy of power production. A case in point is a central station whose engine capacity has varied in the past five years from 4,400 to 5,400 horsepower, located in the East, near the Atlantic seaboard, and gradually being improved from a plant consisting entirely of belted machinery to one now operating direct-connected engine and turbine units. Five years ago the station equipment consisted of ten horizontal return tubular boilers, five cross-compound condensing engines of the Corliss slow-speed type, ranging from 300 to 1,800 horsepower, thirteen Brush arc and three Thomson-Houston arc dynamos, six belted alternators, two direct-connected alternators, and three belted power generators for direct-current service. All told, there were twenty-seven generators in the plant, and the station basement was a complex installation of shafts and pulleys which was mainly the outgrowth of the earliest days of the plant's history.

The cost of coal per ton during the year 1904 was $5.05, bituminous fuel being burned. Hand firing has always been the practice of the station. The output of the plant at the switchboard in 1904 was 3,995,000 kilowatt-hours, and the operating cost in toto was $62,500, or 1.56 cents per kilowatt-hour. The principal items here were coal, 0.915 cent, and station labor, 0.394 cent per unit. These items in their totals were fuel, $36,400; wages at plant, $15,760; oil and waste, $1,478; water, $522; station repairs, $1,316; steam-plant repairs, $4,516; electric plant repairs, $2,492. The operating force consisted of four engineers, five firemen, nine station men, and three machinists.

In 1905 the equipment of the plant underwent comparatively little alteration, but the cost of coal fell to $4.56 per ton, making a difference of 0.2 cent in the fuel cost per kilowatt-hour. The total generated output of the station was 4,216,000 kilowatt-hours, and the total coal consumption was 6,511 tons. The boiler and engine equipment remained the same as in the previous year. By extremely careful operation the station ran its output on 3.45 pounds of coal per kilowatt-hour, and the total cost of manufacture was 1.32 cents. The saving from the preceding year arose mainly through the decreased initial cost of coal and the decreased consumption per unit. The station force was increased by two attendants, and two of the belted alternators were disposed of. In addition to the saving in fuel, the cost of station repairs fell off about $1,000, the cost of steam-plant repairs decreased by the same amount, and electric-plant repairs were about $1,000 lower than in 1904.

The total cost of current production in 1906 was about the same as in 1905, 1.36 cents per kilowatt-hour. Coal cost $4.65 this year; the station force was the same in number, and the increased output to 4,438,000 units brought a slight economy in labor cost per kilowatt-hour, the figure being 0.425 cent. The fuel consumption per kilowatt-hour rose slightly to 0.744 cent. During the year the old boilers of the plant were all taken out and a new installation of twelve units of 250 horsepower each set at work, operating under 140 pounds steam pressure. Three of the belted arc dynamos were disposed of, and the station force remained constant. It is not now feasible to determine the influence of the reconstruction work in the plant during the year upon the efficiency of production.

In 1907 the influence of increasing output and reduced number of belted units operated, together with close control of the payroll, produced a fuel consumption of 3.45 pounds, and a total cost of 1.22 cents per kilowatt-hour. The plant generated 5,108,000 units at a fuel cost of 0.723 and a labor cost of 0.38 cent per kilowatt-hour. The cost of coal per ton this year was $4.66, and the operating staff of the station increased by two men.

The record of the plant for 1908 shows the lowest fuel consumption per kilowatt-hour yet attained, namely, 3.26 pounds. The cost of coal was $4.79 per ton, and the station output 5,400,000 kilowatt-hours. With an increase in energy generated of about 308,000 kilowatt-hours, the company burned only three tons more coal than in 1907. The station force consisted of three additional men, or a total of four enginecrs, five firemen, sixteen station attendants, and three machinists. The boiler equipment remained the same as in 1907. There were four reciprocating engines of the compound condensing Corliss type, aggregating 3,900 horsepower, and in the middle of the year the company installed a 1,500-kilowatt Curtis turbo-alternator. The arc system was changed also from the old direct-current open type of lamps to the magnetite system, the transformation of alternating current from the revolving-field direct-connected alternators and the turbine being effected through constant-current transformers and mercury-arc rectifiers. Only four of the original belted arc machines remained. The total cost of manufacture was $67,441, or 1.24 cents per kilowatt-hour. The cost of fuel per kilowatt-hour was 0.701 cent, and the cost of labor 0.36 cent. Water cost $1,843, or $500 more than in 1907, and oil and waste cost about $450 more. Electric-plant repairs showed a slight increase over 1904, being about $2,300 greater than in 1907, due in part probably to the alterations of the station equipment incidental to the changing of the arc system.

In reviewing the history of five years' power cost in this plant it will be seen that the changes have been gradual, without sweeping modifications in the equipment from year to year, but at the end of the period the station stands with the greatest portion of its equipment modernized, with an output better qualified to give an improved load-factor if power business is properly developed, and with the possibility of operating its engine and turbine equipment harmoniously together in the succeeding years. The cost of manufacture has gradually diminished and the efficiency of the apparatus has steadily been improved. While it is true that a power-cost reduction of 0.25 cent per kilowatt-hour is nothing sensational, it means a saving of over $200 a month for each million units produced in a year.

GOVERNMENT EXPERIMENTS WITH BRIQUETTED COAL.

The Technologic Branch of the United States Geological Survey is about to publish a bulletin giving the results of comparative tests of run-of-mine and briquetted coal on locomotives and on a torpedo boat. These tests were made by Prof. W. F. M. Goss, consulting engineer of briquette tests. While the conditions of firing and draft in the services described above are different in a good many ways from those obtaining when fuel is used under stationary boilers, these results will no doubt prove of considerable interest to steam users in general.

The briquettes made by the government machines have withstood exposure to the weather and have suffered but little deterioration from handling. The use of briquettes in the place of natural fuel appears to have increased the evaporative efficiency of the boilers tested. The smoke produced has in no test been more dense with the briquettes than with coal. On the contrary, in most tests the smoke density is said to have been less when briquettes were used. The use of briquettes increases the facility with which an even fire over the whole area of the grate may be maintained.

In locomotive service the substitution of briquettes for coal has resulted in a marked increase in efficiency, in an increase of boiler capacity, and in a decrease in the production of smoke. It has been especially noted that careful firing of briquettes at intervals is effective in diminishing the amount of smoke produced.

In torpedo-boat service the substitution of briquettes for coal improved the evaporative efficiency of the boiler. It does not appear to have affected favorably or otherwise the amount of smoke produced.

The briquettes used in this series of tests were of a form requiring considerable bunker capacity for their storage, but as the form of the briquette is a detail within control, this objection need not apply to the use of the briquettes in actual service.

The binding material in all the briquettes was water-gas pitch. This material was furnished at the briquetting plant of the United States Geological Survey in St. Louis, at $9 per ton. The least amount of binding material that would make perfect briquettes was found to be five per cent of the weight of the coal. The cost of the binder in one ton of the five per cent briquettes was about forty-five cents. The cost of briquetting, including all charges, is estimated at about $1 per ton of briquettes—that is, the briquetting added approximately $1 per ton to the cost of the coal. As the briquettes were made in an experimental plant, probably the price is not as low as it would have been had they been made on a much larger scale.

The coal selected for the tests was taken from a mine working the lower Kittanning coal bed, near Lloydell, Cambria County, Pa. This coal is a very friable, low-volatile bituminous coal. It was exposed to the weather for thirty days on the way to the St. Louis testing plant before being briquetted. It showed but little change due to this exposure, except a decided increase in moisture, which, however, was eliminated in the briquetting.

The general results of the test justify the following conclusions: The evaporation per pound of fuel is greater for the briquetted coal than for the same coal in its natural state. This advantage is maintained at all rates of evaporation. The capacity of the boiler is considerably increased by the use of briquetted coal. The calorific value of the cinders and sparks is not so high in the briquetted as in the natural fuel. The percentage of binder in the briquette has little influence on smoke density. The expense of briquetting under the conditions of the experiment adds about $1 per ton to the price of the fuel, and this amount does not seem to be warranted by the resulting increase in evaporative efficiency. The final test of the economic advantage gained appears to be against the briquetted coal.

The advantages of greater ease in storing and in making use of a fuel material which is distinctly disadvantageous in its natural state may offset the handicap of the cost of briquetting the fuel. Again, there is a possibility that if this briquetting were carried on on a large scale, the cost might be reduced to a point where it would be an economic advantage to conserve the low-volatile bituminous coal and utilize it in many plants in several sections of the country.

THE CHICAGO ELECTRICAL SHOW.

The fourth annual electrical show, held under the auspices of the Electrical Trades Exposition Company at the Coliseum, Chicago, opened on Saturday, January 16, and will run until January 30. Fulfilling the expectations of those interested in the enterprise, the public has again taken up the show idea with approval, and the record of attendance for the first half of the present week has been entirely satisfactory.

The decorative features this year have been greatly changed, and there is considerably more illumination than has obtained heretofore. The beautiful feature of last year's show—the suspension of three rows of large, decorative chandeliers—has been superseded by a sky canopy effect, heavy colored bunting forming a dome high up over the amphitheatre, the effect of a starlit sky being carried out by myriad low-candlepower lamps, the effect of which has been enhanced by the use of a thermostatic flashing device, which causes the lamps to create a twinkling-star effect.

The naval exhibit has been a centre of much attraction, and this feature can surely be enlarged upon and made one of great value to everyone interested in the part which electrical apparatus plays in the armament and control of the modern battleship.

Working exhibits form a large part of the apparatus on display, and that of the Commonwealth Edison Company is noteworthy in this respect. To the casual observer the "House Beautiful," which was the main feature of the display last year, would probably prove more interesting, but the demonstration of the adaptation of motor drive to machine tools which are used in the manufacturing and processing of a large number of everyday utilities, certainly cannot fail to be of benefit to a great many of the visitors to the show, and the company is to be congratulated upon the arrangement and selection of its exhibit.

ENGINES FOR ISOLATED LIGHTING AND POWER PLANTS.

BY CHARLES L. HUBBARD.

In buildings of large size equipped with their own power plants it has been found that under average conditions electric current may be generated at a lower cost than it can be purchased from a central station. Among the reasons for this is the necessity in any case of employing a chief engineer capable of caring for the equipment of wiring, pipes, pumps, boilers, etc., necessary for the heating and other mechanical equipment, and the belief that a man of such a grade of intelligence may as well have charge of a lighting plant also.

Again, the load in a building of this kind usually all occurs at the same time, so that it would be necessary for a central-station equipment to be sufficiently large to equal the total capacity of all the isolated plants which it replaces. The line losses should also be a considerable factor in making a comparison between the economy of the two methods. In addition to the above the building must be heated for six months, or more, of the year, and exhaust steam will do this efficiently after developing nearly its full power capacity in engine service. As the same months are both cold and dark the power and heating requirements will usually follow each other closely. The expense of putting in high-pressure boilers is but little more than those for heating purposes, and the fireroom will cost but little if any more in the case of a high-pressure plant.

Having seen that under favorable conditions an isolated plant may compete with central-station service, let us now consider briefly the best type of engine to be used in cases of this kind. As this class of service calls for high or moderately high speed, the two important points to be considered are those of condensing or non-condensing and simple or compound engines. Let us consider briefly the first of these.

The advantages gained by the use of a condenser are an increase in the horsepower and greater economy in the use of fuel per horsepower developed. The power exerted by a steam engine during a single stroke of the piston is due directly to the difference in pressures acting upon the opposite sides of the piston. Producing a vacuum in the exhaust line removes the resistance from the exhaust side of the piston, and therefore is the equivalent of adding to the steam side. The value of a vacuum of twenty-six inches of mercury to an engine, making due allowance for the cost of production, may be approximated by considering it equivalent to a net gain of about twelve pounds added to the mean effective pressure. From this it is evident that the amount of power gained bears practically the same ratio to the power developed by the engine when running non-condensing as twelve pounds does to the mean effective pressure when running under the same conditions. The following table gives the average increase in power for engines of different size and speed when run condensing:

Dia. of cylinder in inches.	Area of piston in square inches.	Horsepower added at a piston speed in feet per minute of— 400	500	600	700
12	113	16	20	24	29
14	154	22	28	34	40
16	201	29	36	43	51
18	254	37	46	55	65
20	314	46	57	68	80
22	380	56	70	84	96
24	452	66	82	98	115
26	531	77	96	116	135
28	616	90	112	134	156
30	707	104	130	156	180
34	908	132	165	198	230
36	1,018	148	185	222	259
40	1,256	183	228	274	320
42	1,385	200	250	300	352
46	1,662	240	300	360	423
48	1,809	264	330	390	460
54	2,290	333	418	500	600
60	2,827	412	515	618	720

The desirability of installing a condenser in any particular case will depend upon various conditions, among which are the size and water-rate of the engine, cost of cooling water, cost of fuel, and also to what extent the exhaust steam can be used for heating purposes. The actual saving in fuel in average practice, where cooling water can be had free of cost, or where a cooling tower is used, will run from twenty to thirty per cent in the case of simple engines, and from sixteen to twenty-four per cent for compound engines. In the case of office buildings where the greater part, if not all, of the exhaust steam can be used during the winter months for heating and where the cooling water must be purchased at city rates, there is usually nothing to be gained by condensing, and in many cases it would probably result in a loss. On the other hand, in manufacturing plants where water for cooling purposes can be had free of charge, or in plants where the exhaust steam would be wasted, condensers are very generally employed.

In making a comparison of the economy of running condensing and non-condensing in any particular case it is necessary to compute the annual fuel cost, so called.

The items to be considered in making this up for a condensing plant are as follows:

Fuel for power.

Fuel for heating.

Cost of cooling water.

Interest and depreciation on first cost of engine and condensing apparatus.

For a non-condensing plant the items are:

Fuel for power.

Fuel for partial heating, in case the exhaust steam is not sufficient for this purpose.

Interest and depreciation on first cost of engine.

Interest and depreciation on first cost of additional boiler power, if found to be necessary.

The cost of the above items will vary in different localities and must be taken accordingly.

The quantity of water required to condense the steam from an engine depends upon the weight of steam and temperature of the water. With twenty-six inches of vacuum and cooling water not above 70 degrees F., the amount will be approximately from twenty to thirty times that fed into the boilers. For 80 degrees, thirty-five times, and for 90 degrees, fifty-two times.

The amount in any particular case can be computed by the formula

$$Q = \frac{S - D}{D - I},$$

in which Q equals the weight of cooling water per pound of feed-water; S equals the total heat of exhaust steam above 32 degrees; I equals the temperature of cooling water (initial temperature); D equals the temperature of discharge water (final temperature).

Let us now consider the advantages and disadvantages of multiple-expansion engines.

Assuming a steam pressure of 125 pounds, the best engine economy will be obtained by expanding the steam to about seven times its initial volume or to about fifty-seven pounds gauge pressure. An expansion much greater than this will carry the terminal pressure below the atmosphere, which would result in a loss unless the engine was run condensing or the heating system was connected with some form of vacuum system.

It is evident in office-building practice that under ordinary conditions the plant must be run at about one-half to two-thirds full load in order to provide for the sudden throwing in of an extra load such as might be called for by a sudden de-

mand for extra elevator service or the throwing on of all the lights in a large store or restaurant on account of a coming storm.

It is evident from the above that engines should be designed to give a good economy under average conditions which may be taken from one-half to two-thirds of their full load, and seven expansions should conform to this condition.

At full load there will be between five and four expansions, which, although within the economical range of a simple engine, is decidedly too small for a compound. For this reason it is customary so to proportion the cylinders of non-condensing compound engines that the most economical ratio of expansion will occur at or near full load. The result of this is that when running under load their gain in economy over simple engines is best.

Summing up, we may say that a compound engine may be used to advantage when the conditions of initial pressure and load are such that three expansions in each cylinder, or nine in all, can be obtained, or the unit is so large that it is an advantage to divide the work between two cylinders.

With varying load and limited steam pressure, such as are commonly met with in the average office building of small or medium size, the simple engine has the advantage of compactness, simplicity and better regulation upon sudden changes in load, and can be operated at better economy on one-third load or less than a compound engine at five-eighths to one-half its rated full load.

At seven expansions the compound will show a saving of perhaps fifteen per cent over the simple engine running at four expansions, both running at full load, but when it drops to three-fourths or under, an economy will be shown in favor of the simple engine.

There are, however, advocates of both the simple and compound engines for the same class of work, and various reports in the engineering journals of late have shown some very satisfactory results obtained by the use of compound engines in office building work, even where there was a considerable fluctuation in load. One advantage claimed for the compound engine is that the saving over a simple engine during the summer months when the exhaust is thrown outboard, more than offsets the loss due to underloading.

As in many other engineering problems, it is impossible to state rules which will apply to every case, and the most that can be done is to present the advantages and disadvantages of each type of engine, thus giving the intending purchaser an opportunity to choose the one having the least objectionable features as applied to the case in hand.

The Value of a Waterpower.

The value of an undeveloped constant waterpower is such a sum as when put at a proper rate of interest, say ten per cent, will pay the difference in cost between steam and waterpower, items of cost being considered.

A power which is variable, and which cannot be depended upon throughout the year, has of course less value than that which is constant. In such a case the items for consideration are:

The maximum, minimum and average quantity of water, and length of time when there is no water; all the other items which enter into the value of a uniform power; necessity in nearly all cases for a supplementary steam plant, with the expense of maintenance and running for a portion or all of the time.

The value of an undeveloped variable power is little or nothing if its variation is great, unless it is to be supplemented by a steam plant. It is of value then only when the cost per horsepower for the double plant is less than the cost of steampower under the same conditions as mentioned for a permanent power, and its value can be represented in the same manner as the value of a permanent power has been represented.

To determine the market value of such a power which has been developed it will be necessary to consider the power by itself independent of the plant; that is, to determine first the value of the power as though it were undeveloped, and then to determine the value of the improvements. The sum of both will represent the value of the power as developed.

It might happen in some cases that the value of the privilege would be a minus quantity, but that the value of the improvements more than offset that, thus making it of value in the developed state.

The cost of developing a power originally will not always represent the value of the improvements, except in so far as it relates to the character of the work done. Considering the work properly and substantially done, the value of that work immediately after completion may not be represented by its cost. A certain power may cost to develop twice as much as another of equal power, the difference in cost being due to difference in head or some other natural cause; but, all other things being equal, the one which cost double has no more value than the other because it produces no more.

The actual value of a plant would depend upon the amount of depreciation which had taken place; or, better, upon the number of years which it would run without renewing.

The value of the plant will be its cost, less depreciation, up to the point where the cost of waterpower equals that of steampower; for it would be justifiable to make an expenditure up to an amount which would give as good financial returns as any other source of power. Beyond this point, when waterpower costs more than steampower, the value of the improvements would not be represented by their cost.—*From a paper by Charles T. Main, mill engineer and architect, Boston, Mass.*

An Electric Hygroscope.

A comparatively simple hygroscope, which is direct-reading in terms of the scale of a galvanometer, is described by J. Pionchon in a French scientific journal, whose account is abstracted in a recent number of *Science Abstracts.*

The action of this hygroscope is based upon the conducting path afforded by the moisture attracted to a clean glass surface, which deposit has been found closely proportional to the humidity of the atmosphere. A glass tube four inches long, closed at one end, is silvered inside and out to within half an inch of the open end. The bottom is then cut off, leaving a fresh cut which separates the two silver surfaces. This cut, which is the sensitive portion of the instrument, is polished with fine emery. Wires are connected with the inner and outer coatings and are inserted in a circuit containing a galvanometer and a battery of 100 volts. The deflection of the galvanometer is then found to vary greatly with the moisture of the atmosphere. The mere approach of a moist body affects it. The hand held at a distance of half an inch produces various effects in accordance with the part which happens to be near the sensitive surface. The point of the finger, for example, throws the spot off the galvanometer scale. The amount of moisture liberated by the heat of the hand from a paper tube is easily detected. The zero of the instrument is said to be constant and rapidly recovered.

Electrical Section of the Western Society of Engineers.

The first meeting this year of the Electrical Section of the Western Society of Engineers was held in the rooms of the society in the Monadnock Block, Chicago, on Friday evening, January 15. The annual election of officers of the section for the year 1909 resulted in the unanimous choice of Wm. B. Jackson as chairman, Prof. P. B. Woodworth, vice-chairman, and W. L. Abbott, member of the executive committee for three years. In the absence of the new chairman, Professor Woodworth presided. In assuming the chair he called attention to the history of the Electrical Section and urged the formation of an affiliated electrical society for young men in Chicago to provide lectures and discussions of the more elementary technical subjects and to act as a feeder for the parent society's membership.

As the main feature of the evening, Prof. C. F. Burgess, of the University of Wisconsin, read a paper on "Boiler Corrosion as an Electrochemical Action." Iron corrosion is a general term that signifies many kinds of ailments in iron. Although these are commonly attributed to various causes, it is coming to be believed extensively that all iron corrosion is essentially of an electrolytic nature. A firm advocate of this hypothesis is Dr. A. L. Cushman, who has made extended investigations of this subject. If this action is electrochemical, the corrosion of iron is readily explained by the iron at the anode of a local couple going into solution. As an example, iron and copper in the presence of even a weak electrolyte form an active couple. The hydrogen set free by such action collects as a protecting film on the cathode, and this stops the incipient action. The presence of free oxygen in the liquid promotes corrosion, not by directly attacking the iron, but by combining with the hydrogen on the cathode, and thus reducing the polarizing film.

Professor Burgess's attention was directed to corrosion of boiler tubes by an investigation on corrosion in locomotive boilers he began at the university laboratories in Madison, Wis., at the request of the Chicago, Milwaukee & St. Paul Railway. Marked pitting was generally found on the lower inner surface of the bottom tubes and decided grooving near the ends of the tubes remote from the fire box. In some cases the tubes seemed to be intact and the shell of the boiler was pitted. A small experimental boiler was set up with a tube insulated from the shell by means of asbestos bushings. Terminals were attached to the tube and shell and a milliammeter and millivoltmeter connected to the external circuit. Readings of the instruments were taken for various conditions with many different solutions. Although the tube and shell were of substantially the same material, currents were detected at practically all times, even with the boiler nearly cold. These ranged from values so small that the most delicate galvanometer was required to detect them, 0.018 or 0.020 ampere. Usually on heating, the current rose to its maximum value and remained near this point till the heat was removed. When soda ash or barium hydrate was added to the water, the current reversed on the second application of heat, so that the tube became the cathode. This phenomenon explains why, in some sections of the West where alkaline feed water was used, the pitting was noticed on the shell of the boiler instead of the tubes.

While these studies are by no means complete, they have indicated that corrosion cannot be entirely eliminated. Among the suggested methods of rendering it nearly harmless were: To use such materials in the feed water as would make it least active as an electrolyte; to concentrate the corrosive action on some non-vital part of the boiler that was readily and cheaply replacable; to place in the boiler zinc or some other electropositive material on which the action may spend itself. The problem is a very complex one and needs careful analysis in each particular case.

In concluding his paper Professor Burgess showed a large number of lantern slides illustrating corrosion in boilers, sheets that had been locally heated, bars that had been stretched or twisted, rivets and rivet holes, common nails, etc. In every case there was conclusive evidence that the parts that had been locally strained were more actively corroded, due to being the anodes in local couples, with the unstrained metal as cathodes. These facts, therefore, explained the corrosion and grooving of the boiler tubes; the lower tubes and the remote tube ends were evidently anodes because of the great temperature differences between them and the adjacent boiler shell.

The discussion of the paper was participated in by Prof. P. B. Woodworth, W. L. Abbott, D. W. Roper, R. F. Schuchardt, Professor Burgess and others. It was pointed out that zinc and even mercury had been used in boilers, with apparently no beneficial results, although under certain conditions they might have been valuable. The use of an external neutralizing current might have some disturbing influence on the collection of scale. A singular thing had been noticed in the very marked corrosion of pipes carrying distilled water; this upsets the general opinion that distilled water is not an electrolyte. As to the minimum electromotive force that causes corrosion, Professor Burgess said he believed there was no minimum. The common belief that 1.5 volts is necessary applies to the decomposition of water. However, iron can be electrolytically dissolved with very minute but long-continued electromotive forces.

Aero Association Plans $240,000 Prizes.

The International Association of Aeronauts, at its session in London, has adopted a resolution that the Federation should found prizes to the value of $240,000 for flying machines and dirigible balloons.

The plan provides for ten prizes of $20,000 each, half of this number for dirigible balloons and half for flying machines, together with a $10,000 cup in each department.

These ten prizes, it is proposed, shall be competed for in ten separate competitions, one to be held every five years. The suggestion was made that the United States, Germany, Great Britain and France should each contribute $40,000 to this fund, and Belgium, Spain, Italy and Austria $20,000 each. Twenty thousand dollars is to be devoted to the construction of portable sheds for the competing machines.

Two More Pennsylvania Railroad Tunnels Under Manhattan and the Rivers.

The story has been current in Wall Street that the Pennsylvania Railroad, as permitted according to the terms of its franchise, is to begin at once the building of two more tunnels under the East River, North River and Manhattan Island, to parallel the present four tunnels under the East River, and three under Manhattan Island.

It is said that the next two tunnels will be used as a connecting link between the New York, New Haven & Hartford and the Pennsylvania trunk lines, for the transportation of fast freight.

CONDITIONS AFFECTING STABILITY IN ELECTRIC-LIGHTING CIRCUITS.—II.[1]

BY ELIHU THOMSON.

The various forms of series arc lamps involving differential lamp-magnet mechanism of one type or another, secure in greater or lesser degree the floating arc condition, as distinguished from the "fixed separation," a feature of some types. As exemplifying the importance of this regulating feature upon current stability, the writer may perhaps be permitted to recall an early experience in arc-dynamo design. The first series arc machine designed and built under his supervision, was also the first dynamo having the three-coil (star three-phase) winding with three-segment commutator. This machine, at a speed of 750 revolutions per minute, ran a series of eight lamps at ten amperes, with forty-five to fifty-volt arcs, and survived room temperatures of a bakery in the midsummer of 1879 in Philadelphia, the thermometer on the wall nearby showing sometimes 120 up to 140 degrees Fahrenheit in the early evening with the ovens in full operation. The machines had been carefully proportioned in the light of all available information which could be discovered at the time. There was very little to guide one in this task. Nevertheless, the current of the machine was stable at the current for which it was designed, although no experimental machine had preceded it. Further, there was no change needed in the windings, and it remained in service for years thereafter.

Several similar machines were made after the trial of this first one. Following these, there was constructed in 1880 a small compact machine for a circuit of sixteen arcs in series, but the proportions were less conservatively chosen, and the armature strength was less in proportion to the field, so that, regarded from a later standpoint, the armature raction was too small to give a proper droop in the characteristic at the current value of ten amperes, for which it was designed. The iron sections were also liberal. It was found capable, when driven at 800 revolutions per minute, of maintaining its full quota of lamps, but although the lamps had the series magnet-regulating feature, the current was decidedly unstable, and only became so at higher values, about fifteen amperes, too high for the safety of the windings. It was observed, however, that if in the circuit there was introduced a single supersensitive lamp, or one in which comparatively large extensions or shortenings of arc length followed quickly upon minor current changes, an artificial stability was produced, which, in spite of the evidently unsuitable characteristic, as now regarded, allowed the lamps to be operated at their intended current of ten amperes, or even less. The behavior of the dynamo as to heating and efficiency, etc., was then satisfactory.

On account of the relatively high duty of the machine, less weight of wire and cost, it became actually a debatable point whether the supersensitive regulating lamp might not be shut up in an iron box and maintained as a permanent part of the circuit in practice. Later work, however, developed the fact that by changing the manner of commutation, the same machine became quite stable at the current intended, but at a sacrifice of output which could only be met by running at a somewhat higher speed.

Another and curious stumbling block, so far as stability of current was concerned, was met later. Several sizes of Thomson-Houston arc dynamos were designed and built at New Britain, Conn., in 1882-1883, giving perfectly stable current without dependence on the regulating action of lamps or floating arc condition. The manufacture was removed to Lynn, Mass., in the fall of 1883, with the result of importing instability of current. The same patterns and proportions were used, all elements of construction apparently being retained. A change had been made in the lamp mechanism whereby there was now no longer any dependence of arc length on the current fluctuations, the control of arc length and feed being obtained by a derived circuit or shunt potential magnet only. At first it was thought that this change in the lamp mechanism was the reason of instability, and, as assisting to that conclusion, experiments showed that the Lynn-built machines could operate a circuit of lamps having differential magnets (differential lamps) smoothly, and without instability.

As a remedy for the trouble, and one resorted to while the true cause was being investigated, there was established a short-circuit band of copper wire around the field cores parallel to the winding. This device at once gave stability to the current with both types of lamp. Meanwhile it had been determined that machines built in New Britain could operate with a stable current with either type of lamp in circuit, showing that they at least were independent of the floating-arc condition, or did not need the regulating effect of the lamps to insure stability. It was further found that machines built in Lynn from castings made in New Britain gave stability with either type of lamp. This led to the suspicion that in the cast-iron itself lay the true cause. Analysis showed manganese in the New Britain iron and very little in the Lynn foundry iron. Special melts made in Lynn with the same mixtures of pig-iron as were used in New Britain gave at once stable current and ended the difficulty without recourse to the closed copper band on the field, which demanded the sacrifice of considerable copper.

If anything will serve to show the pitfalls to which the arc-dynamo designer was subject, the above incident should suffice. The difference in the iron was evidently a difference in magnetic stability, rigidity, or hysteresis. In a dynamo machine the iron of which is magnetically stable or rigid, as when the hysteresis loop is wide, there is an absence of response to minor current fluctuations, which response is one of the causes of instability in series-wound machines. Put differently, it may be that there is an ascending characteristic curve, derivable from current and potential determinations while these are increasing, and a descending characteristic derivable from similar determinations, while these are diminished or diminishing. The greater the difference between these two, the greater the stability of current, and the further down toward the origin one may work without instability. In machines with large iron projections on the armature core, such as the Brush arc machine, it is likely that there would be but little difference ascending or descending, owing to the magnetic vibration accompanying the operation of the machine; but it is conceivable that with steadily driven, smooth-core armatures the hysteresis of the field iron would be a controlling factor. Doubtless, in the case above described, a study of the magnetic qualities of the two irons would have disclosed the difference, so important in its practical effect.

In apparatus in which potential differences of thousands of volts had to be maintained with only a single slot in the commutator between the brushes at such great potential differences, it can readily be understood that flashing or arcing over

1. Abstract of a paper read before the American Institute of Electrical Engineers, New York City, January 8.

a slot might short-circuit or reduce the line current so much as to introduce a different kind of instability. Such a flashing or arcing in the slot was of the nature of an alternating arc. A segment of the commutator left the brush with a small trailing spark, showing a diminishing current reaching zero at a small distance in advance of the brush. Immediately thereafter the potential of the segment was reversed and attained a high opposite value, which, as an alternating arc, would jump the zero current position, especially if any heated gas remained in the slot. The writer has been frequently credited with having adopted as a bold expedient the well-known air-blast mechanism to blow out the sparks at the commutator. Nothing could be further from the fact or more mistaken. The real function of the air blast was to insure the non-existence of heated gas at the zero current, to replace it with cold air and prevent the possibility of the next alternation re-establishing the arc and short-circuiting the commutator over the single slot between positive and negative brushes. The action to be secured was carefully reasoned out in advance of its trial and application. Without it the instability of circuit conditions would have rendered operation entirely impracticable, owing to incessant alternating arcs between commutator segments. Although these considerations apply to apparatus which is rapidly being replaced by other means of distribution, the writer feels justified in here presenting them as matters of history not generally understood.

The arc-light dynamo devised by Chas. F. Brush was the pioneer machine in series arc work, and it is proper to inquire as to the features which made it successful so far as stability of current was concerned. It was early shown to possess a drooping external characteristic, but it is safe to say that in the earliest types there was still dependence upon the regulating feature of the lamp or floating-arc condition. The lamps were of the differential type. It is also a fact that the peculiar property conducing to stability, both in the earlier and more recent designs, was largely due to an almost critical proportioning of the proper extent and relative sections of the pole horns adjacent to the armature on each side. In a conversation with Mr. Brush in 1878 the writer remembers that he laid emphasis on the fact that even in the single-arc machines then before us, a comparatively slight variation in spacing or the arc covered by the pole-pieces would destroy the stability of current, so that, as he said, he could do nothing with the machine. The later Brush machines of large capacity for multi-circuit work up to 125 arc lights or more, many of which have been built at Lynn, Mass., depended more than ever on the close proportioning of armature and field, and more particularly upon the form section, material, and arc covered by the pole horns. By careful adjustment an external characteristic curve having an almost vertical droop at a current value a little beyond the working current strength was obtained, rendering the current stable regardless of the regulating effect of lamps, and leaving but little to be done in regulating for variations of number of lamps in circuit.

In Fig. 1 are given three characteristics taken from one of the most recent Brush machines constructed for working magnetite-arc lamps at four amperes at a total circuit voltage of 15,000, multi-

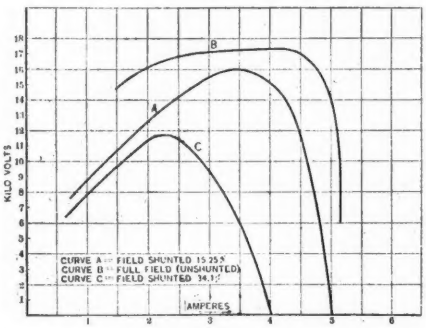


FIG. 1.—CHARACTERISTICS OF FORM H BRUSH ARC DYNAMO.

circuit plan. In regulation the machine is shunted more or less and brushes adjusted automatically for variations of load. Curve A, with a little over fifteen per cent of the field current shunted and brushes fixed, indicates that the normal current point is well over on the droop which at five amperes corresponds to short-circuit or no voltage. With curve B, or unshunted field, the normal current point lies on the horizontal part of the curve, which then droops rapidly at about 4.75 amperes, and would indicate a probable short-circuit current about 5.5. Curve C shows the normal current value of four amperes at no voltage and indicates the condition when all lamps are shunted and the field shunted, in this case to the extent of 34 per cent of its current. Curve A shows ample stability. Curve B indicates an approach to instability, probably capable of being prevented by the regulating feature of the lamps or floating-arc condition. Curve C is, of course, an indication of most perfect stability and it will be readily understood that as the load is cut off in passing from A to C the margin of stability will increase steadily.

It is interesting to note that in most of the early Brush machines there was applied around the field cores a closed copper band to increase the stability or prevent surging. The closed band served to render the field magnetism less sensitive to quick changes occurring in the current of the machine, by permitting the induction of opposed currents in the band. The magnetism was thus rendered more stable and the changes in it more sluggish.

The later work on the Brush dynamo has been ably carried out by C. M. Green at Lynn, and this machine, on account of lending itself readily to multicircuit working, is still constructed, though the output is now relatively small. On account of the great dependence of the working and current stability upon the relations and proportions of the pole horns, it may almost be characterized as a "pole-piece" machine in contradistinction to one in which there is either an absence of pole horns or in which, if they exist, their form and disposition exerts no vital influence on the working, particularly as concerns the stability so essential where the load consists of arcs.

It seems probable that on account of the simplicity of the wiring the series, constant-current circuit will be employed for a long period in the future for arc lighting in street service and for large spaces. The advances recently made in high-efficiency luminous flame arcs will doubtless be a potent factor in future development.

When the enclosed carbon arcs were substituted for open arcs on direct-current circuits, it was recognized that a sacrifice of efficiency of light production with a given energy was involved. This was offset, however, by the other well-known advantages accruing. No noticeable change in the stability of the circuits was discovered when the substitution was made. When, however, the alternating-current open arc, itself less efficient than the direct-current arc, came to be enclosed it was found that the sacrifice in efficiency was such that aside from the white color of the light of the arc there was no advantage over incandescent lamps using the same energy.

The introduction of alternating-current arcs in lighting occurred very early, as in the lighthouse lamps mentioned. But

the introduction of the so-called Jablochhoff candle in 1878 was, however, the first attempt to apply it in general illumination. The candles had some of the features of the luminous arc, inasmuch as they smoked and consumed a solid substance, such as kaolin, besides the carbon. The candles were operated several in a series. Little is known of the stability conditions in such circuits, but in Paris in 1878 the alternating dynamo current was not carried directly to the lamps, but the lamp circuits were operated through huge condensers in such manner that several series of lamps were fed from the single current of larger value split up through the condensers. It is possible that this use of condensers in the distribution served to limit the current values and secure stability. Later attempts to apply open arcs of the alternating type on series circuits from constant-current transformers, met with little encouragement. Not until the success of the enclosed arc on direct current had been fully demonstrated was there any considerable opportunity to make use of series alternating-current arcs. The enclosed alternating arc operated from constant-current regulating transformers gave the opportunity. The system permitted the employment in the station of generators of large capacity with constant-potential mains, to which the primaries of the transformers could be connected at conveniently located substations, while the secondary-arc circuits became independent, so that leaks or grounds on one did not affect the other. This was a manifest advantage.

Fortunately no difficulty arose in securing stability of current values in constant-current transformer distribution. The reactance, or more properly the general impedance of the system including the alternating lamp magnets, which themselves assist materially, resulted in a fall of potential with increased current, and the reverse, at a rate sufficient to insure stability. The characteristic curve plotted with current as abscissas and volts as ordinates would in the constant-current transformer droop as in the arc machine, but it would droop steadily from zero current outward. In other words, the potential is at a maximum with zero current, while in the series-field arc machine, except for residual magnetism, zero current corresponds to zero potential. Were, however, the primary and secondary coils of the transformer allowed to come too near together the condition would approach too closely that of a constant-potential transformer. The leakage magnetism between primary and secondary coils when as close together as permissible will give rise to considerable reactance values, which, as the load on the secondary is cut off, will gradually increase as the secondary is repelled to a greater and greater distance. It is necessary that the movement of the coil be effectually damped, by dash-pots or the like, or an instability due to overrunning akin to hunting will take place during changes of load. The direct-current arc dynamo with its heavy series-field coils is likely to have so much self-induction as to tend to steady the current values so far as very rapid fluctuations are concerned. When, however, the field, as in the Brush machine, is shunted more or less for regulation, this influence of the field inductance is neutralized, at least to a large extent. With the alternating-current circuit there is, of course,

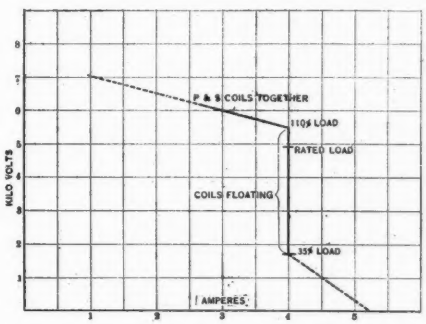


FIG. 2.—CHARACTERISTIC OF CONSTANT-CURRENT TRANSFORMER.

an entire absence of such influence upon stability; but in this case the resistance and self-induction in the whole circuit traversed by the current is sufficient for securing stable values of current. These conditions giving rise to stability naturally involve a lessened power-factor in the system, and, as is well known, the distortion of the current wave in an alternating arc while not in the nature of a true lag, reduces the power-factor. It is probable also that the tendency to instability in an alternating-current arc is not so great as in the direct-current arc, for the arc undergoes extinguishment at the zero and does not relight until after the potential difference between the electrodes has reached a considerable fraction of the maximum.

In the more recent work with magnetite arcs and with lamps having electrodes which, for satisfactory operation, demand the employment of direct current, there was at one time a tendency to return to the use of motor-driven arc dynamos giving small current values and high potentials. The development of the mercury-arc rectifier and its apparent special adaptability to the rectification of small currents at high voltage has naturally led to its employment in conjunction with the constant-current transformer for securing direct currents suitable for series-arc circuits. The practical results so far obtained with oil-immersed mercury rectifiers have been so generally satisfactory as to indicate an extended future application.

Oil-bath immersion has given control of the working temperature of the rectifiers. If too low, the condition imports instability. If too high, there is danger of breakdown. Fortunately it appears that normal working demands such moderate temperatures as are easily maintained in the oil bath. Alteration of vacuum by leakage, or by gradual giving out of gas may result in the accumulation of a body of insulating gas around the anode, interfering with the normal ionized mercury-vapor stream which conducts the current. This may cause a fading out of the rectified current, in turn causing the lamp to lower or drop the electrodes together, and thus again allow increase of current which again separates them, and so on; a condition of surging or oscillation somewhat akin to the instability of an arc circuit when working too close to the critical point on the characteristic. Lowered vacuum also endangers the rectifier by causing excessive stresses near the anodes, which may puncture the glass. Suitably-spaced shunting gaps may be provided around the rectifier as a safeguard against excessive stresses. The temperature of the rectifier tube can also be maintained by circulation of air by a fan, where oil is not used. The plant includes, besides the rectifier and constant-current transformer, additional alternating-current reactance, and a direct-current reactance in the rectified current circuit, the proportions of which are chosen to insure as far as possible steadiness in the working.

If a characteristic be plotted it takes the form given in Fig. 2, which is properly the regulation curve. The vertical line at four amperes shows the range of constant current between 110 per cent load and thirty-five per cent of full load in kilovolts, the latter point corresponding to the greatest separation of primary and secondary coils as provided for in the construction of the transformer. Thus,

even at short-circuit the current will then not exceed 5.25 amperes. As a rule the circuit is adapted to the operation of lamps in which the arc length is either "floating" or fixed, without involving instability of current. Hence the lamps may be constructed to lift the upper electrodes and separate them to a definite distance and to drop them together at feeding, which in the case of long-burning electrodes would occur very infrequently. As indicating the endurance of the mercury-arc rectifier itself, it may be incidentally mentioned that some of these in service have attained upward of 5,000 hours' life and are still operating. The system has the advantage of permitting arc lamps to be operated from twenty-five-cycle circuits, and while the direct current is then more pulsating than in the case of higher frequencies, it is still satisfactory. The power-factor at full load ranges about seventy per cent and the efficiency is about ninety per cent. Increase of the power-factor would probably result in instability of current.

Before closing, the conditions governing the stability of an arc or arcs in branches from constant-potential mains may be briefly referred to. As before stated, instability is then at a maximum and current values may rise to the proportions of a destructive short-circuit. If the regulating mechanism of the lamp extends the arc, or the reverse, in response to current variations, a violent surging or oscillation with extinction results. Hence the necessity of the choking-coil, whether there be one or more arcs in series across the mains. With continuous currents a dead resistance which will cause a drop of from twenty to thirty per cent of the total potential is generally inserted. The condition for stability is that the resistance shall drop the potential at the arc with increase of current at a greater rate than that caused by increase of current in the arc itself, and vice versa, as is well known. This involves a serious loss of energy and many efforts have been made to reduce or minimize it. It is usual to allow the floating arc to exist and in such a case the dead resistance may be cut down, if in the arc branch a large self-induction be inserted, a reactive coil which introduces a time-lag in the current variations allowing the regulating action of the lamp magnets to come into play. Better yet, if the lifting magnet be made a shunt of many turns around the more coarsely wound reactance or reactive coil (as invented by Higham) a supersensitiveness in the lamp mechanism is obtained which causes it to anticipate current changes or at least compensate therefor in increasing and diminishing the arc length and so preventing the fluctuations attaining any considerable value. Still more effective is the arrangement in which, as in Fig. 3, the arc adjusting coil C in shunt to the reactive coil R is made to move in the field of the latter used as a field magnet M. These arrangements permit a direct-current arc to be operated between constant-potential mains with a minimum of dead resistance in series with it. Unfortunately, the saving with the carbon arc is of little practical value where a single enclosed arc is put in a branch across 110-volt mains. While the voltage at the arc may be thus increased from eighty volts to 100 or thereabouts, the gain in light does not correspond to the increased arc energy, on account of

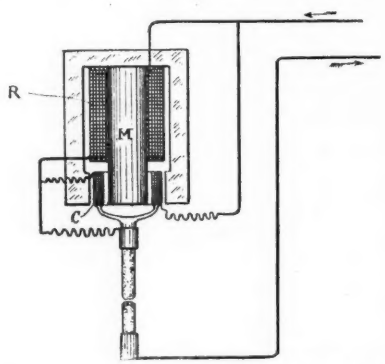


FIG. 3.—DIRECT-CURRENT ARC LAMP.

the comparatively low luminosity of the arc flame itself. It is possible that where the arc flame is the source of light, as in luminous arcs, the expedient may give practically valuable results, though that remains to be seen. In the case of the alternating arc across lines at constant potential, stability is readily obtained by the introduction of an impedance, or reactive coil, which need not involve any considerable loss of energy, but of course its effect is to diminish the power-factor of the system, to which also the distortion of wave in the alternating arc itself may add.

Higher Tariff Proposed on Mica.

An increase of the duty on certain grades of mica has been proposed which, while it affects electrical manufacturers to a large extent, also affects the stove manufacturers and hardware trade, as the tendency now in these industries is to use very small pieces of mica where many years ago large sizes were used.

The United States Geological Survey has compiled statistics of the production of mica in, and of its importation into, this country, from which the following table has been taken. The total consumption of mica in the United States is practically equal to the sum of that produced and imported:

	Produced in United States.		—Imported—	
Year.	Pounds.	Value.	Pounds.	Value.
1905.....	924,875	$160,732	1,188,449	$ 296,362
1906.....	1,423,100	252,248	2,412,261	731,488
1907.....	1,060,182	349,311	3,448,452	1,295,606

Amber mica is produced only in the provinces of Ontario and Quebec, Canada; therefore there is little disposition to controvert the claim that it should be admitted free or with little duty. It is proposed to raise the duty on white mica, however, from its present rate (six cents per pound, plus twenty per cent ad valorem) to double this rate, with the object of furthering the American mica industry. White mica is chiefly produced in India and is classed according to the following commercial sizes:

No. 6, having an area of 1 to 3 square inches.
No. 5, having an area of 3 to 6 square inches.
No. 4, having an area of 6 to 10 square inches.
No. 3, having an area of 10 to 16 square inches.
No. 2, having an area of 16 to 25 square inches
No. 1, having an area of 25 square inches and over.

When the present duty was established the small sizes of mica were not extensively used. Now that they are used, the duty on them varies from fifty to 150 per cent, as against twenty-five per cent or less on the larger sizes. Under the proposed schedule a specific duty of $240 per ton, plus forty per cent ad valorem, would be asked on white mica.

During the year 1907, when the price was about double that of 1905, the American production, according to the table above, was but fifteen per cent greater than that of 1905. The increase of price of about sixty per cent had, however, resulted in an increase of importation of nearly 300 per cent. This shows conclusively what has been quite generally known, that the mica deposits in this country are not of a character that can displace imported mica for electrical purposes. The number of men employed in mica mining in the United States has probably never exceeded 1,000, even when the production was at its maximum. The number of people, however, affected by an increased duty and who would pay the enormous tax proposed is great and consists largely of manufacturers of electrical apparatus and users of electric current and the makers and users of stoves. Instead of any increase of duty, a lowering of the tariff on the smaller sizes of mica should be demanded.

Progress in Submarine Bell Signaling.

A good deal has been achieved in the direction of protecting shipping by means of submarine bell signaling, says the London *Times Engineering Supplement.* Everything points to the fact that important extensions in the direction of providing bell signaling stations are likely to take place in the near future, lighthouse authorities in this country and abroad—as well as shipping interests—having been greatly impressed by the successful working of existing installations. The bells at present employed in this system of signaling have been considerably improved as the result of careful tests carried out by lighthouse authorities, and it should be noted that in evolving the latest form of bell the engineering staff of Trinity House have given this subject considerable attention. The form of the apparatus used in this system of submarine signaling naturally varies according to the purpose to which it is to be applied. Three forms of bells are now employed—the electric bell, operated by an electric current from the shore; the pneumatic bell, which is employed in lightships or at the end of a pier; and the bell buoy, which is operated by the action of the waves.

As illustrating the extension of the system, it may be stated that over 100 submarine bells have now been placed in position. Of these fifty-three have been fixed within United States waters, both the western and eastern shores being thus protected, while Canada has now twelve bells in service. In the case of England, where the Mersey Docks and Harbor Board took the initiative in equipping the Bar and Northwest lightships, there are now ten bells in service. The lightships equipped by Trinity House include the Outer Dowsing, the Tongue, East Goodwin, Royal Sovereign and the Nab. The bell buoy fitted near the latter lightship off Spithead for experimental purposes a year ago has, it is stated, given very satisfactory results in service, and it is probable that the Trinity House authorities will order additional installations in connection with bell buoys in British waters. The Irish Lights Commissioners are also moving in the matter, and have under consideration installations for the Kish and other lightships. In all over 500 ships are now equipped with the receiving apparatus, these ships being mostly engaged in the transatlantic trade, where, as is evident from what is stated above, the provision of submarine bells has reached its greatest development. The northern coast of Europe is also fairly well protected, Germany having installed ten bells, France six, the Netherlands seven, and Denmark, Sweden and Spain one each.

British railway companies running steamship service are alive to the importance of submarine signaling, and the London and North-Western Railway, in conjunction with Trinity House, is interested in a scheme for putting a bell down at Holyhead, in which case the London and North-Western Railway Company proposes to equip with receiving apparatus fifteen of the vessels running in the Holyhead service. The London and South-Western Railway has in contemplation the equipment of vessels running between Southampton and Havre, following the placing of two bells at the latter port. Developments are also in progress with a view to giving protection to shipping running to Mediterranean and eastern ports. A bell has already been ordered for Tarifa, in the Straits of Gibraltar, and it is in contemplation to place a second bell at Europa Point, in which case the other side of the Straits would be equipped with two bells, one probably at Tangier and the other at Cape Spartel. The Spanish and Portuguese governments will watch the working of the bell at Tarifa, and if that gives satisfactory results will establish bell stations, among other points at Vigo and Cape Ortegal, Cape Roca, the Burlings, Leixoes and Cape St. Vincent. Ushant is now about to be equipped, so that the French, Spanish and Portuguese coast will then possess fairly adequate protection. In the Far East, the Japanese authorities are beginning to move, and the Chinese government intends to place a bell at the mouth of the Yang-tse-kiang. Steps are also being taken to equip the South American coasts, the governments of Brazil, Argentina and Uruguay having interested themselves in the matter.

Another important application of submarine bell signaling relates to inter-ship communication, and tests in connection with submarines have been carried out by practically all the governments interested. The problem to be solved is an important one, as hitherto there has been practically no means by which a submerged vessel could communicate with other ships. In this case both the sending and the receiving apparatus is employed, and although the authorities are naturally reticent as to what has actually been done, it is known that the trials carried out by the British Admiralty and by the Navy Board of the United States have given satisfactory results. It should be possible, as experiments have shown, to employ the Morse code for signaling between submarine vessels. It should be noted that a distinctive character is given to the signals sent by submarine bell installations, so that bells may be easily identified. In some cases the number of the lightship is repeated on the bell signal, the only exception to this rule being the bell buoys, which are operated by the action of the waves. In addition to equipping its lightships with submarine bells, the Trinity House authorities are also employing wireless telegraphy for communication between lightships and the shore. Six lightships in all are now fitted with such plant, including the Sunk lightship, the Tongue, and the Cross Sand, and three lightships on the Goodwins.

Metropolitan Receivers File List of Expenditures.

Receivers Joline and Robinson for the Metropolitan Street Railway, New York city, have filed answers in a suit brought by a number of companies which supplied funds, material and construction work to the Metropolitan Street Railway and the New York City Railway companies and others, in which they deny that they received through the operation of the property between September 24, 1907, and June 30, 1908, a sum in excess of $13,220,000. They admit as receivers of the two street-railway companies that they borrowed $640,743 and used cash on hand from the inception of the receivership amounting to $607,291. They admit that while acting as receivers for the New York City Railway Company they made these expenditures:

Pay roll	$5,465,001
Water rates and taxes	785,606
Materials and supplies	2,657,831
Rents of lines operated under leases	3,067,412
Replacement of property destroyed by fires	651,951
Sprinkler equipment, etc.	101,447
Completion of First Avenue line	115,029
Track work	270,428
Construction work	264,418
Horses	108,875
Incidental operating expenses	344,882
Motive power, machinery, new cars, etc.	943,874

The receivers also deny that the expenditures were not correctly made and say that in all respects they acted within the instructions of the court.

ALTERNATING CURRENTS AND THEIR APPLICATIONS.

BY EDSON R. WOLCOTT.

CHAPTER III. (PART III)—MOTORS.

REPULSION MOTORS.

When an alternating magnetic field is made to link with a coil of wire, induced electromotive forces are set up tending to produce currents in such directions as to create a magnetic field opposing the first, or generating, field flux. The magnetic field produced by the induced current reacts with the fluctuating magnetic field which generates it, and the result is a repulsive force which tends to move the coil out of the magnetic field. When the coil is fixed to rotate on an axis the repulsive force tends to move it so that no lines of force pass through it. In the ordinary armature there are a number

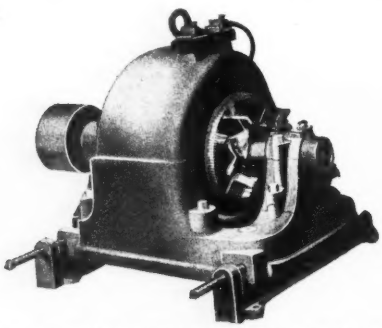


FIG. 73.—SINGLE-PHASE INDUCTION MOTOR WHICH STARTS AS REPULSION MOTOR.

of coils equally spaced from each other, and when these are all short-circuited the individual effects, when combined, neutralize each other and no motion results. Rotation does take place, however, when the coils are short-circuited successively. A machine utilizing this method is illustrated in Fig. 73, which represents a single-phase induction motor arranged to start as a repulsion motor. The line current passes into the field winding only, the armature currents being developed by induction. The windings of the armature or rotor are connected to the segments of the commutator as shown. The brushes are connected together through a heavy conductor, and in this manner the windings of the armature are short-circuited successively during rotation. In this condition the machine is a repulsion motor and sufficient torque is developed to start it. When brought up to speed an automatic centrifugally-operated device short-circuits all of the individual segments, as shown in the sectional drawing, Fig. 74, and the machine then runs as a single-phase induction motor. The automatic centrifugal device is contained inside the armature as shown at V. At the designed speed the throw of this weight

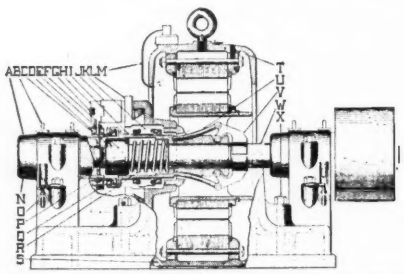


FIG. 74.—CROSS-SECTION OF INDUCTION MOTOR ARRANGED TO START AS REPULSION MOTOR.

overcomes the spring, pushing the short-circuiting ring K into contact with the segments of the armature. When the motor stops the ring returns to its standstill position under the action of the spring and the machine is ready to start again.

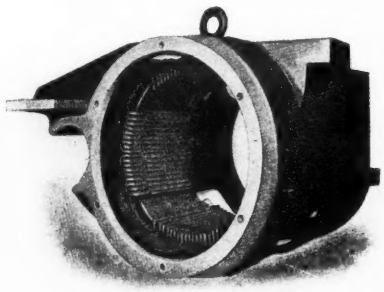


FIG. 75.—FIELD OF SINGLE-PHASE SERIES MOTOR, SHOWING NEUTRALIZING WINDINGS.

This device permits of successful operation of single-phase induction motors on circuits which are subject to interruption, such as the running of elevators, hoists, cranes and the like.

SINGLE-PHASE SERIES MOTORS.

As has already been explained, a direct-current motor will operate on an alternat-

FIG. 76.—SINGLE-PHASE SERIES MOTOR FOR RAILWAY SERVICE.

ing-current circuit, but new difficulties are then encountered on account of the inductive effects of the alternating current. The direction of rotation of a direct-current motor, as is well known, is not changed by reversing the current terminals of the machine. Since, when the current is reversed in the armature, it is also reversed in the field coils, the direction of rotation remains the same. To effect a reversal of direction it is necessary to change the connections between the armature and the field.

However, when a rapidly reversing current, such as an alternating current of common frequency, is applied to an ordinary direct-current motor the effects of the inductance offered by the windings are such as to prohibit very successful operation.

In the case of a shunt-wound motor, the reversal of the current through the field coils produces a change in polarity of the magnetic field. The current and magnetism in the armature lead the current and magnetism in the more highly inductive fields. The result is a difference in phase between the excitation and the armature current, and but little torque is developed.

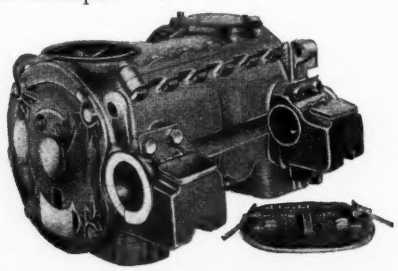


FIG. 77.—SINGLE-PHASE SERIES MOTOR FOR RAILWAY SERVICE.

COMPENSATION OF ARMATURE INDUCTANCE.

In the case of the series-wound motor the most serious difficulty is that due to excessive sparking. As already explained, on breaking a circuit containing inductance a considerable spark is produced, the magnitude of the spark depending on the amount of energy stored in the magnetic field. It is possible to reduce this action considerably by means of a neutralizing or compensating winding. The magnetic field produced by a direct current flowing through a solenoid can be neutralized by arranging another winding, closely surrounding and similar to the first but carrying an equal current flowing in the opposite direction. One solenoid tends to form a magnetic field with lines of force in one direction, the other tends to produce a magnetic field with lines of force in the opposite direction; the result is no magnetic field.

When this compensating coil is connected in series with the original the com-

bination effects what is called "forced compensation" or "forced neutralization."

A very similar effect is obtained when the compensating winding is short-circuited. A current is then induced therein, the direction of which is opposed to that in the original. The resulting magnetic field of the compensating coil, therefore, tends to annul that produced by the original. This is known as "inductive" or "transformer neutralization."

In Fig. 75 the field members of a single-phase series motor are shown, the field coils having been removed so as to expose the neutralizing windings to view.

PREVENTION OF SPARKING.

Various methods of preventing sparking have been proposed by inserting both ohmic and inductive resistances in the field coils. In the latter case the inductive resistance acts as a choke coil.

APPLICATION OF SERIES MOTORS.

The special application of single-phase series motors is to electrical railway service. No motor has yet been found which surpasses the series motor for use on a circuit requiring high starting torque and high efficiency throughout a considerable range of speed. The series motor is the one in general use on direct-current trolleys, and the alternating-current type is meeting similarly with favor.

For electric railways having several miles of track the question of transmission becomes a very important one, and accordingly the application of alternating currents is necessary for high economy. If a direct-current trolley is used, substations must be erected every few miles to convert the high-voltage alternating current into direct current at from 500 to 1,000 volts. If the alternating-current series motor is used the trolley wire itself may serve as the transmission line, the voltage being reduced in the car to about 500 volts, the pressure at which this type of motor operates.

The single-phase series motor cannot operate at as high a voltage as the direct-current motor of the same type because of the sparking difficulties. It has the further disadvantage of being nearly twice as large for a given rating.

Fig. 76 and Fig. 77 disclose two views of the single-phase series motor as constructed for railway service.

In August, 1904, the Ballston-Schenectady (N. Y.) railway was equipped with single-phase motors, being probably the first railway to install single-phase apparatus in this country.

The Public Service Commission's Report.

The annual report of the Public Service Commission for the first district of New York, which includes New York city, composed of William R. Willcox, chairman, William McCarroll, Edward M. Bassett, Milo R. Maltbie and John E. Eustis, commissioners, has been submitted to the State Legislature.

In a chapter summarizing the work of the Commission is told the results of that body's activity through the full calendar year ended December 31, 1908. The Commission made requisition upon the city authorities for expenses outside of their salaries and the cost of counsel, and a secretary, which are taken care of by the State, for $1,095,000. The year's work was completed, however, on an even million dollars. For 1909, the city has been asked for $987,500. About sixty per cent of the expenses are due directly to transportation problems.

The Commission received, during the year, 3,000 complaints in regard to service rendered by the transportation lines, and 9,000 complaints affecting gas and electric corporations. Ten applications requesting the approval to a total issue of $13,010,000 stock, $92,404,000 bonds, and $50,000,000 notes or evidence of indebtedness, were received, and the issuance of $3,000,000 stock, $41,742,000 bonds, and $25,000,000 notes was allowed.

The Commission reports that it ordered the complete and thorough overhauling of all the surface cars in Manhattan and the Bronx, as a result of which noise caused by rattling cars with flat wheels has been greatly decreased, car efficiency increased, their appearance improved, the cost of operation lowered, and the safety of the public better protected. The Metropolitan's cars, which were in such wretched condition that twenty per cent could not complete a day's service without being put in the barn for temporary repairs, have been overhauled, so that these repairs are now made on only five per cent of the cars. The receiver of the Third Avenue has likewise reduced the number of complaints against his road.

There were nearly 50,000 accidents during the year, resulting in the deaths of 600 persons. The Commission is soon to require the installation on cars of fenders and wheel guards which have proved satisfactory in tests conducted by experts.

According to the report, the cars in New York city carry annually over 1,300,000,000 passengers, or sixty-six per cent more than the total number carried on the steam railroads of the entire country. The local companies have a capitalization of over $533,000,000 and derive annually from passengers $62,000,000. Gas and electric companies are capitalized at $386,000,000, and from the sale of electricity over $20,000,000 a year is received.

Over $50,000,000 has been spent by the city to build subways and the construction of the Fourth Avenue, Broadway-Lexington Avenue system, loop lines and the Canal Street extension will cost $100,000,000 more. The Commission calls the construction of these new subways imperative and says that even they will not fully relieve present congestion, not to mention future increases.

Commenting on the offer to the city of the Steinway Tunnel, the Commission says that the Interborough's proposition that the city should purchase it and then lease it back under an agreement to pay one-half the cost of operation and to receive all the fares from passengers riding through the tunnel only, would cost the city at least $350,000 a year, and it is deemed inadvisable to accept the offer.

Application of the City Island Railroad Company and the Pelham Park Railroad Company for change of motive power from horse to electricity, which has been approved, means a practical test of the new monorail system, which, it is hoped, will bring about a cheaper method of transportation in the outlying districts of the city.

Electrical Exposition at Worcester, Mass.

The city of Worcester, Mass., has under way a mechanical and electrical exposition of which the Worcester County Mechanics' Association is the prime mover. The facilities, say the projectors, for manufacturing possessed by firms in the central part of Massachusetts is not surpassed in any section of the country, and it will be the object of the Worcester exposition to impress this fact upon the buyers and users of manufactured goods. The exposition opens March 27. The details have been put into the hands of H. F. Campbell, an experienced manager. Mechanics Hall will be used for the mechanical department, showing machinery in operation manufacturing goods, and Washburn Hall on the floor below will be devoted to the electrical department. The halls will be tastefully decorated, the special display being in the electrical section.

Convention of Northwestern Cedarmen's Association.

The annual meeting of the Northwestern Cedarmen's Association was held at the West Hotel, Minneapolis, Minn., January 11 and 12. The attendance was larger than usual and the reports submitted at the meeting indicated that the outlook is favorable for material improvement in the cedar situation, which has been far from gratifying during the last year, the demand for poles having been most adversely affected by the financial reverses of 1907-8. Members of the association who are well informed and close observers of market conditions, however, expressed themselves at this meeting as being able to discern signs of improvement and inclined to the view that, considering the amount of stock on hand and the probability of resumption of work by railroads, telephone and telegraph companies, etc., the demand will increase sufficiently to wipe out the price demoralization of recent months.

During the convention an address was delivered by President Naugle and Secretary M. O. Nelson read his annual report, while a number of committee reports were presented, among them those from the committees on car stakes, insurance, advertising and railroads. The report of Treasurer B. W. Thomas showed a substantial balance in the association treasury.

Officers of the Cedarmen's association for the next year were elected as follows:

President—E. L. Clark.

Vice-president—T. M. Partridge.

Treasurer—M. B. Thomas.

Directors—J. W. Benham and A. D. Watson.

Ernest L. Clark, the new president of the Cedarmen's Association, was born in Chicago, June 4, 1868, and entered the cedar business under his own name in 1889. Mr. Clark was married to Miss Lillian R. Shaw, of Bloomington, Ill., April 10, 1890. They have two children, a son who is attending Racine College in Wisconsin, and a daughter, at Kemper Hall, Kenosha, Wis. In 1892 E. H. Valentine, formerly western manager for the Walter A. Wood Reaper and Mowing Machine Company, entered the business, and a new company was organized, known as the Valentine-Clark Company. Mr. Valentine remained with the company until 1905, when Mr. Clark assumed the presidency and bought out Mr. Valentine's interests, the latter retiring from the business, although the same company name has been retained. Mr. Clark has long been identified with the electrical trade in the handling of cedar poles. As his company deals exclusively in this line, he is naturally brought into contact with large electrical houses, telephone and telegraph companies and interurban railways. The association, of which he has just been honored with the presidency, controls ninety-five per cent of the entire cedar output, aggregating probably $10,000,000 to $15,000,000 a year.

Among those in attendance upon the sessions of the convention were:

H. W. Anthes, Torrey Cedar Company, Clintonville, Wis.

J. W. Benham, Naugle Pole and Tie Company, Chicago.

M. K. Bissell, Erickson & Bissell, Escanaba, Mich.

T. P. Bradley, Duluth Log Company, Duluth, Minn.

MR. E. L. CLARK, PRESIDENT NATIONAL CEDARMEN'S ASSOCIATION.

G. J. Backus, Backus-Judd Lumber and Cooperage Company, Minneapolis, Minn.

H. L. Brooks, Hall L. Brooks Company, Tomahawk, Wis.

Neil Burrell, Valentine-Clark Company, Chicago.

E. L. Clark, Valentine-Clark Company, Chicago.

W. C. Church, W. C. Church Lumber and Coal Company, Des Moines, Iowa.

M. H. Coolidge, Coolidge-Schussler Company, Minneapolis, Minn.

M. H. Coolidge, Jr., Coolidge-Schussler Company, Minneapolis, Minn.

H. M. Dixon, Cloquet Tie and Post Company, Cloquet, Minn.

George Everson, Deer River Lumber Company, Minneapolis, Minn.

George J. Farnsworth, Bay De Noquet Company, Nahma, Mich.

J. E. Gerich, MacGillis & Gibbs Company, Milwaukee, Wis.

R. R. Genge, Francis Beidler & Company, Chicago.

H. S. Gilkey, Pendleton & Gilkey, Minneapolis, Minn.

L. L. Hill, Page & Hill Company, Minneapolis, Minn.

J. C. Kirkpatrick, National Pole Company, Escanaba, Mich.

A. D. McIntyre, National Pole Company, Escanaba, Mich.

J. A. McDavitt, Cloquet Tie and Post Company, Cloquet, Minn.

John P. Miller, Minneapolis Cedar and Lumber Company, Minneapolis, Minn.

William Mueller, Jr., William Mueller Company, Blaney, Mich.

W. C. Moss, McCulloch & Moss, Minneapolis, Minn.

A. T. Naugle, Naugle Pole and Tie Company, Chicago.

J. W. Naugle, Naugle Pole and Tie Company, Chicago.

M. O. Nelson, secretary, Minneapolis, Minn.

E. C. Norton, Kellogg Switchboard and Supply Company, Chicago.

L. A. Page, Page & Hill Company, Minneapolis, Minn.

T. M. Partridge, T. M. Partridge Lumber Company, Minneapolis, Minn.

H. F. Partridge, T. M. Partridge Lumber Company, Minneapolis, Minn.

H. W. Reade, National Pole Company, Escanaba, Mich.

P. W. Raber, Raber & Watson, Chicago.

W. B. Thomas, White Marble Lime Company, Manistique, Mich.

F. E. Wenzell, Deer River Lumber Company, Minneapolis, Minn.

W. T. Watkins, Joyce-Watkins Company, Chicago.

T. R. Wall, Torrey Cedar Company, Clintonville, Wis.

C. H. Worcester, C. H. Worcester Company, Chicago.

Ed Arnold, Itasca Cedar Company, Deer River, Minn.

M. H. Schussler, Coolidge-Schussler Company, Minneapolis, Minn.

The Minneapolis committee in charge of arrangements comprised H. S. Gilkey, chairman; Marshall H. Coolidge and F. M. Partridge.

Chair in Aeronautics.

The first aeronautic professorship in the world has been founded by the University of Goettingen, Germany, Dr. Ludwig Prandl of the mathematical and physical faculty having been assigned as professor.

THE CHICAGO ELECTRICAL SHOW.

FOURTH ANNUAL DISPLAY OF THE ELECTRICAL TRADES EXPOSITION COMPANY AT THE COLISEUM, JANUARY 16-30.

An inspiring scene of latest progress and invention, busy with the operation of hundreds of labor-saving and convenient electrical devices, its artistic paths and pergolas and exquisite color-scheme illuminated by thousands of tungsten lamps, and all stretched picturesquely under a vault of profound darkness, spangled with twinkling stars—the fourth annual Electrical Show opened at the Coliseum, Chicago, January 16, to the crash of military bands, the whir and roar of machinery and the delighted exclamations of the crowds of people who attended, both those of the electrical inclining and the laity.

The first inspection upon entering the door of the Coliseum revealed the different decorative treatment that had been accorded the arched roof and the interior, a grateful departure from the scheme of the year before. The booths themselves were similar to the style of previous years, signs and architecture being pleasantly uniform. The boundaries and aisles were marked by graceful posts and arches, carrying cap pieces of Japanese contour, which supported rows of frosted tungsten lamps. Arches, posts and booths alike were given a rich creamy tint, which caught up the illumination of the high-efficiency units with peculiar effectiveness.

Overhead a starry sky was depicted with the aid of deep blue bunting and hundreds of tiny incandescent lamps scattered indiscriminately over the great arch. Delicate and realistic tints of red and blue had been added to some of the 1,000 two-candlepower lamps which made up the stellar display, and the illusion of a real firmament was heightened by the aid of "firefly" flashes in the lamp circuits, which caused the star-points to twinkle in the most approved fashion. The effect of an intensely deep black sky was further carried out by the use of a trick known to the stage, of arranging a dense row of bright lamps at the border of the sky-field.

The centre of the hall was marked by an immense chandelier carrying 300 red, white and blue lamps. At each end of the main exhibition space radiant auroras were formed of colored bunting brilliantly illuminated with searchlights. With the numerous electric signs and the special illumination furnished by the exhibitors the scene was one of great brilliancy and beauty. The effect of an open sky, so realistically portrayed, provoked the favorable comment of everyone.

On the arches 1,131 twenty-five-watt tungsten lamps are used. The large posts are decorated with 910 forty-watt tungstens and the small posts require 455 more. The line of border lights represents about 1,800 lamps, so that counting in the star-lamps, chandelier and exhibit-

GENERAL VIEW OF THE FOURTH ANNUAL ELECTRICAL SHOW, COLISEUM, CHICAGO, JANUARY 16-30.

ors' lights at least 6,000 lamps are aglow during the show.

The main hall was given over to the booths of exhibitors representing a great variety of electrical apparatus and supplies of every imaginable description from the electric automobile to the electric incubator and the electric flatiron to a 250,000-volt transformer.

One of the most interesting exhibits was that carried out in the industrial exposition of the Commonwealth Edison Company, of Chicago. This division, which in fact comprised a community of industries, occupied the north section of the room. Among the operations performed by electric power was the electrical driving of the following: Linotype machine, printing press, wood embossers, wood-carving machinery, lathes, friction saw, gag punch, bevel shear, punches, shoe-repairing machinery, knitting machines, cloth cutters, welding apparatus, binding and embossing machinery, electric ovens, dough mixers and potato peelers.

The Coliseum Annex was given over to the naval display. In the centre of the floor there had been erected the deck of a battleship, the U. S. S. Electra, and visitors boarding the vessel over the side found the ship-shape equipment of a modern man-o'-war with a full complement of electrical signaling devices. On the bridge were mounted the regulation wheel and compass, with electrical steering dials, signal discs, truck-light controller, searchlight and semaphore signal arms. On the deck below was a standard wireless telegraph outfit operated by students from the naval college. The battleship was armed with a number of Gatling and other rapid-fire guns, and several pieces of repelling armament throwing projectiles weighing from one to six pounds.

The naval exhibit also comprised a very fine miniature model of the battleship Illinois and blue-print diagrams of the various hoisting and turret-motor circuits and wireless telegraph systems employed on modern battleships. Exhibits by the United States Hydrographic Office, the Illinois Naval Reserve and the recruiting service completed the list of matters of interest in the annex.

One of the exhibits on the floor which attracted a great deal of attention from both electrical men and the general public was the spray test of a number of suspension insulators at 250,000 volts, conducted by the Electrical Testing Laboratories, New York. A large testing transformer was supplied with 440-volt current from a special motor-generator set up in the building, and delivered a pressure of 250,000 volts across three suspension-type insulators upon which a fine water spray was projected. The heavy power arc, thirty inches in length, playing over the insulator shells, attracted many interested observers.

The large booth of the Westinghouse Electric and Manufacturing Company contains a number of examples of the company's transformers and transmission-line equipment, including lightning arresters, circuit-breakers, ammeters and voltmeters. A variety of motors and generators for both direct and alternating current, and a complete exhibition of domestic and industrial heating appliances, together with several types of flaming-arc lamps, complete this interesting exhibit.

To Chicago electrical men the exhibit of the Murphy Electricity Rectifier Company is a novelty. This alternating-current rectifier uses no vacuum-tube or electrolyte, but operates, as the inventor, T. J. Murphy, explained, on the principle of producing a high-tension spark at certain periods of the alternating-current cycle, using the path thus formed to convey the dynamic discharge of power current which is thus supplied to the load as a unidirectional flow.

The General Electric Company's booth displays an array of the latest improvements in electrical heating and lighting devices. The company's representatives are calling special attention to the new skeleton sanitary bread-toaster, the gun-metal flatiron, and an inexpensive cigar-lighter. The exhibition of tungsten and carbon-filament lamps is an important feature of this exhibit.

The Central Electric Company is devoting a goodly portion of its exhibit to a line of artistic lighting fixtures, fitted with the new "Opalux" shades for use with tungsten lamps.

The Baker Electric Vehicle Company shows a handsome electric brougham and a compact mercury-arc rectifier for charging automobile batteries from an alternating-current circuit.

The Northern Electrical Manufacturing Company presents a novelty in a working exhibit of an electric rock-drill, eating its way into a great block of stone. The electric motor drives, through gearing, a centrifugal hammer which delivers powerful blows on the drill, which is meanwhile slowly rotated to remove the debris from the hole.

In conjunction with the exhibit of the Mechanical Appliance Company, which builds the electrical equipment, there is shown a sterilizing process for treating flour and grain with nitrogenous products derived from the air. A 500-volt direct-current generator is connected to a reactance coil and revolving spark-gap. A direct-current reactive discharge approximating several thousand volts is thus secured in the path of a draft supplied by a blower. The air leaving the chamber laden with fixed nitrogen is then led to the flour to be treated, effecting a very perfect sterilization. The company is also exhibiting an electrically operated crossing gate, adapted for supply from trolley circuits.

The Chicago Telephone Company has a six-position standard Western Electric switchboard in operation, supplying service to the telephones in the Coliseum, with which each booth is equipped. The American Telephone and Telegraph Company in an adjoining space shows several systems of telephone train dispatching.

The Allis-Chalmers Company is showing, besides an extensive line of motors and generators, a number of models illustrating the construction of steam turbines of its manufacture. An Allis-Chalmers alternator is in service in the impromptu Coliseum substation, to supply three-phase alternating current to exhibitors at the show.

The Chicago Pneumatic Tool Company devotes a double section to a display of electrically driven drills, boring machines, hoists, etc. The electric drills which attract a good deal of attention, are driven by two armatures, working on a planetary gear, the armatures being included in the same circuit of field flux. This construction feature makes the drill-motor case comparatively flat, for close work, and permits of the central location of the lead screw.

Electrically operated systems of vacuum cleaning occupy a great deal of attention at the 1909 Electrical Show, no less than ten exhibits devoted to this important domestic application of the electric motor being shown. The companies are: The Cyclone Vacuum Cleaning Company, Duntley Manufacturing Company, Connersville Blower Company, Electric Suction Sweeper Company, Electric Cleaner Company, General Compressed Air Company, Illinois Electric Renovator Sales Company, Milwaukee Vacuum Machinery Company, Perfection Vacuum Cleaner Company, Palm Engineering Company.

A thermal fire-alarm device which is said, in a series of tests, to have reported invariably from one to five minutes before the first automatic sprinkler or other alarm device operated, is exhibited by Malcolm H. Baird. A closed loop of fine copper tubing is connected to a delicate bellows carrying an electrical contact. Any undue rise of temperature expands the air in the tube, raising the bellows and closing the contact, to send in the alarm.

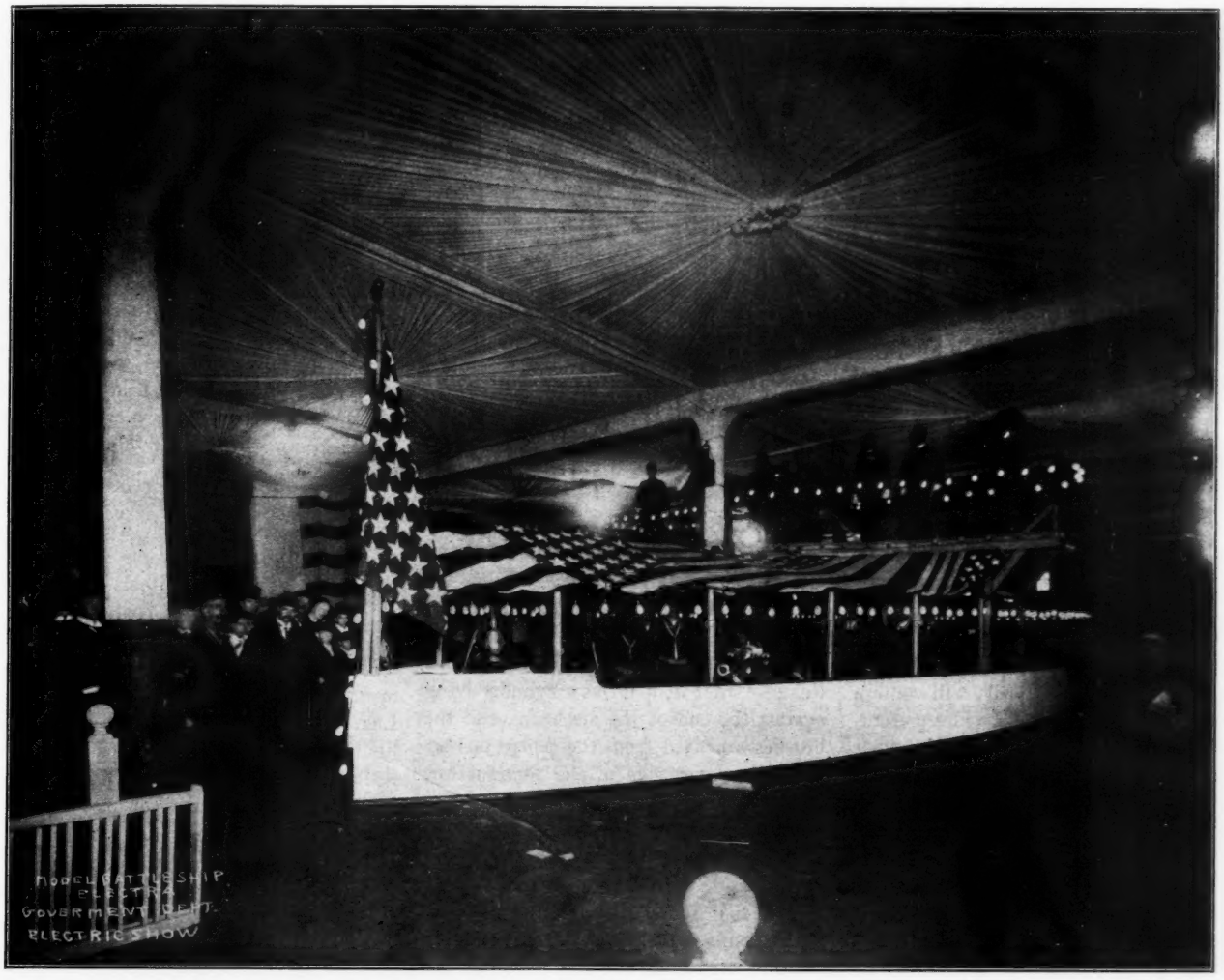
frames of the machines it manufactures. A moving-picture machine included in this booth, is controlled with Fort Wayne apparatus.

The Federal Electric Company has devised an electrical representation of a waterfall, to illustrate the variety of effects of which its flashing signs are capable.

A booth that occasions considerable domestic interest, is that of the Hurley Machine Company, which illustrates how by flexible couplings the motor in the electric hoist, grinders and buffers, and a complete line of fan motors, including the popular nine-inch fan which attracted so much attention last year.

The Excello Arc Lamp Company has a handsome model, made of finely polished brass, of its flaming-arc-lamp mechanism. This lamp is fitted with carbons to give a light very white in color.

Saturday, January 16, was opening day. On Monday, January 18, souvenirs of Billikin pins were given away. Tuesday



THE NAVAL EXHIBIT AT THE FOURTH ANNUAL ELECTRICAL SHOW, COLISEUM, CHICAGO, JANUARY 16-30.

Hatching chickens by electricity during the show is being successfully performed by the Cyphers Incubator Company, whose "electric hen" is always the centre of an interested crowd.

The Cutler-Hammer Manufacturing Company is displaying a very fine exhibit of electric controlling devices. A number of ammunition-hoist controllers of this company's manufacture are also exhibited in the naval exposition at the Annex.

The Fort Wayne Electric Works shows a striking contrast in size of the field

Thor electric washer may be arranged to perform numerous household operations.

The Kellogg Switchboard and Supply Company exhibits an interesting display of telephone apparatus, including several novelties in switchboard construction.

The Robbins & Myers Company is showing a fine line of its "Standard" motors, operating printing presses, exhaust and pressure ventilating fans, a motor immersed in a tank of water, an alternating-current motor driving a sewing machine equipped with a foot-treadle controller, an

was Army and Navy day; Wednesday, Chicago Electric Club day; and Friday, Northwestern Electrical Association day.

Saturday, January 23, is to be students' day, and the remaining week will be arranged as follows:

Monday, January 25—Souvenirs.

Tuesday, January 26—Telephone day (souvenirs).

Wednesday, January 27—Sons of Jove.

Thursday, January 28—Thomson-Houston day.

Friday, January 29—Theatrical day.

Central Stations in the United States.

A preliminary report on the central electric-light and power stations in the continental United States, exclusive of Alaska and the insular possessions, has been prepared by the census bureau of the Department of Commerce and Labor, of which S. N. D. North is director.

The statistics, arranged in the accompanying table, relate to the years ending December 31, 1907, and June 30, 1902. The totals include central stations only. They do not include isolated plants, or plants that were idle or in course of construction, and in but few instances lighting plants operated by electric-railway companies. The final report will contain an analysis of these totals, besides presenting detail statistics by states and for other phases of the electrical industry.

CENTRAL STATIONS IN THE UNITED STATES.

	1907.	1902.	Per Cent of Increase.
Number of establishments	4,714	3,620	31.2
Commercial	3,462	2,805	23.4
Municipal	1,252	815	53.6
Total cost of plants	$993,613,622	$504,740,352	97.5
Total income (1)	$175,612,338	$ 85,700,605	104.9
Lighting service	$125,755,114	$ 70,138,147	79.3
All other electrical service	$ 43,859,577	$ 14,048,458	212.2
All other sources	$ 6,027,647	$ 1,514,000	298.1
Total expenses	$134,196,911	$ 68,081,375	97.1
Salaried employes—			
Number	12,990	6,986	85.7
Salaries	$ 11,733,787	$ 5,663,580	107.2
Wage-earners			
Average number	34,642	23,330	48.5
Wages	$ 23,686,537	$ 14,983,112	58.1
Supplies, materials and fuel	$ 44,458,568	$ 22,915,932	94.0
All other expenses (including interest on bonds)	$ 54,318,019	$ 24,518,751	121.5
Steam and gas engines (including turbines)—			
Number	7,674	6,095	25.9
Horsepower	2,684,228	1,392,122	92.8
Waterwheels—			
Number	2,474	1,390	78.0
Horsepower	1,347,487	438,472	207.3
Total kilowatt capacity of dynamos	2,642,403	1,218,735	116.8
Output of stations, total kilowatt-hours	5,858,121,860	2,507,051,115	133.7
Estimated number of lamps wired for service—			
Arc lamps	(2) 555,921	385,698	44.1
Incandescent lamps	(2) 41,807,944	18,194,044	129.8
Stationary motors served—			
Total horsepower capacity	1,649,026	438,005	276.5

(1) Exclusive of income for current used for light and power that was furnished by railway companies, and which is included in the report for street and electric railways.
(2) Exclusive of lamps used by the establishments reporting to light their own properties.

Electrical Features of the Paris Automobile Show.

The annual Automobile Show is one of the events of the year at Paris, not only for the automobile industry proper, but also for the electrical and various other lines of manufacture. A departure from the usual practice was made on the occasion of the present exhibition in the Grand Palace, the show being divided into two portions, making really two expositions of a different kind and held at different dates. Thus the first show, held from November 28 to December 13, included for the most part light and standard automobiles and accessories. The second exhibit was then installed, the latter exhibition taking place from December 24 to December 30.

The greater number of the exhibits which interest the electrical industries were at the second show, although in the first exhibition there were noted several electric cars which presented some interesting features. One of these was the car manufactured by a Paris firm known as the Electromotion Company. It is distinguished from the usual types of electric car by the arrangement of the motor, which is mounted in the centre of the wheel and forms the hub. The motor has an internal fixed field, which is mounted on the end of the axle. Around it is an armature of cylindrical form. From the outside of the armature there are short radial spokes, which connect with the rim. The commutator is necessarily reversed in this case, that is, it forms a cylinder lying against the end of the armature, and the brushes are fixed from the centre to bear upon the inner side of the commutator. A device used to suppress the sparking, consists of an extra brush mounted along with each of the ordinary brushes, being spaced from the latter by a considerable arc, so that the short-circuiting now occurs upon a larger number of turns, or rather a certain fraction of the armature winding. The peripheral speed of the motor on the usual run is 2.10 metres per second, compared with the usual figure of eight or nine metres, so that the wear is lessened and the brushes are better kept in place. The suppression of the harmful effects of the armature reaction allows of starting the motor very quickly or of giving it a high overload without sparking at the brushes.

Electricity applied to agriculture was represented in the exhibit of a system of plowing machines of the Fillet type, constructed at Paris. The plow is drawn across the field by means of a cable which winds upon a motor-driven drum, this latter being mounted in a four-wheeled car of suitable design, which is anchored in the soil. The car carries a 500-volt, three-phase motor of forty-five horsepower capacity, which drives the cable-drum through gearing. Where current is not to be had, there is designed a portable generating outfit, which is also on exhibition.

An interesting exhibit was that of electric-furnace steel, which is produced in the electric plant at Ugine, France, by the Girod system. Such steels are now turned out on a commercial scale in widely differing grades, and are claimed to be superior to Siemens-Martin steel and equal to the best grades of crucible steel. The Girod process, owing to its simplicity, allows of obtaining very regular products, which are carefully checked in chemical and mechanical laboratories. Such metal is produced in ingots, blooms or rolled or forged bars. Tool steel is one of the most noteworthy of the grades produced.

There were numerous exhibits of stationary petrol motors and motor-dynamo groups. The well-known firm of Panhard and Levassor showed a new type of light-motor group giving eight or nine horsepower, which is especially useful for agricultural purposes or in the small industries. The motor, which has a single cylinder, can work with gasolene, benzol, or alcohol, by using a suitable carburetter. It can also be run with coal gas or producer gas. In this case a carburetter is used which has a special mixing arrangement. Another motor group is the Fiat Lux, which is designed for producing lighting current. Such groups have been installed in the fifth floors of houses in Paris without difficulty, owing to their quiet running. Using coal gas, the cost of current is about one-third of the city current rates, and with gasolene the cost is claimed to be one-fourteenth of the municipal schedule.

Engineer for the Indian Service.

The United States Civil Service Commission announces an examination on February 17, at the usual places, to secure eligibles to fill a vacancy in the position of engineer (competent to take care of pumping plant, tank house, etc.), at $720 per annum, for the Indian Service, Fort Berthold, N. D., and similar vacancies as they may occur in the Indian Service, commanding salaries from $480 to $1,000 per annum. Applicants should write to the Commission at Washington for application form 1093.

THE ECONOMICAL DEVELOPMENT OF TOLL TERRITORY.—III.

BY FRANK F. FOWLE.

CIRCUIT LOADS AND OPERATOR LOADS.

Those companies which charge for toll service on the basis of one rate schedule for all hours of the day have no means of controlling the variation of the public demand from hour to hour of the day. Facilities must be provided to handle the traffic in the maximum period, or during the peak load; at other times the facilities will be underloaded and the only economy possible is a reduction at such times of the operating force. From the standpoint of economy in operation there are two things to be sought for: first, the highest feasible circuit load during the peak load period, and second, an arrangement of the hours of the operating force so that the force corresponds at all times to the load. The load curves are prepared from traffic data which show the number of calls handled each hour or half-hour throughout a day of twenty-four hours; a half-hour period is to be preferred on account of rather rapid changes in the load at several periods of the day. A typical load curve, under a fixed schedule of rates, is represented in Fig. 3; the characteristic of this type of load curve is a double peak, the one in the forenoon corresponding to the maximum traffic, and a small evening load after 6 p. m. The load curves of all offices are not precisely identical, but will vary among themselves as to the relative prominence of the morning and afternoon peaks and the evening load; the curves for one office prepared at different times of the year will usually show slight variations. Fig. 3 shows the characteristic load on any week day from Monday to Friday inclusive; on Saturday the afternoon peak is missing and on Sunday there is no pronounced peak whatever.

The load curves under a graded rate system are materially different from Fig. 3. The following illustration (Fig. 4) shows the characteristic loads under a night half-rate schedule between 6 p. m. and 6 a. m. It shows a typical load curve for any week day from Monday to Friday, inclusive; the prominent characteristic is a triple peak, one peak in the forenoon which is the maximum, one in the afternoon and one in the evening. The evening peak is not materially different from the afternoon peak, except that it is usually slightly less in magnitude and shorter in duration than the latter; in some instances, however, the evening peak may exceed the afternoon peak.

There is one characteristic quantity or value in such load curves by which they may be compared with one another, and from which some idea may be formed as to the distribution of the load; this quantity is the ratio of the average half-hourly load for an entire day to the maximum load for that day, and is termed the

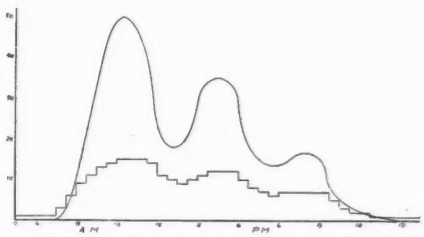


FIG. 3.—HOURLY TRAFFIC LOAD AND FORCE ON DUTY.

load factor. A large load factor corresponds to an evenly distributed load with no very prominent peaks; a small load factor corresponds to an unevenly distributed load with at least one prominent peak. A large load factor is most to be desired, because the plant facilities which it is necessary to provide to carry the peak load will at other times be idle only tc a slight extent; the degree of idleness at periods other than the peak load

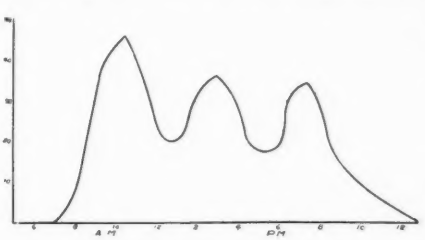


FIG. 4.—HOURLY TRAFFIC LOAD WITH NIGHT HALF RATES.

period will diminish as the load factor increases, and vice versa.

It is pertinent to emphasize at this point the effect upon the load factor of graduating the rate schedule during the hours of the day in proportion to the public demand for service. While it is recognized that recent tendencies in some cases have been toward a fixed rate schedule throughout the day rather than a graded schedule, it is believed that the real motive has been a desire to increase revenues without raising the day rates. And it is further believed that such a plan is not in the end the most economical one to the telephone companies or the most satisfactory to the public. In one instance a comparison of conditions before and after an abolition of a night half-rate revealed a decrease of the load factor from 29.5 to 27.3 per cent, and an increase in the morning peak load of 9.1 per cent; the absolute decrease in the load factor amounts to 7.5 per cent. The resulting increase in total revenue, other things remaining constant, will be roughly ten per cent, and in case no additional facilities are provided to take care of the increased peak load, the net earnings will be increased correspondingly as regards absolute amount, and in a much greater ratio on a percentage basis. The result on the service will be to increase the subscribers' average wait from giving a call to the establishment of connection, during the peak load period and for a short period thereafter until the delayed business has been cleared up. In the event that sufficient additions are made to the office plant and the pole-line plant to carry the extra peak of the load without impairing the quality of service previously given, and in the event also that the operating force is adequately increased during the peak load period, the increased revenue will be largely absorbed by increased expenses and fixed charges. The ultimate economy of the plant is therefore in question, and even though a small net economy can be shown when the speed of service is not impaired by the change, the whole tendency is to throttle development instead of stimulating it, and the plan is believed, therefore, to be economically wrong.

The change from a fixed rate schedule to a graded rate schedule, with day and night rates, will logically involve a slight increase of the day rate as well as a substantial reduction of the night rate from the previous fixed rate, because a part of the day traffic will be transferred to the night period in order to take advantage of the lower rate. Experience, moreover, does not indicate that halving the night rate will fully double the night traffic, and the immediate effect upon the total revenue will be a loss, unless compensated for by a small increase in day rates. On the presumption that there were adequate plant facilities to give reasonably good service before the rate change, the drop in the peak load which will result from the change will leave a small margin of spare facilities and postpone for a time the necessity of adding to the plant. After the traffic has grown up to the facilities once more the accompanying in-

1. From a paper read before the International Independent Telephone Association, Chicago, Ill., December 1, 1908.

crease of revenue will increase the net profits, and it may then be possible to scale down all the rates uniformly on this account. There will be further advantages under a triple schedule of rates as compared with a double, or day and night schedule as just described. This has never, so far as known, been actually tried, but it is submitted as a logical and rational plan for securing a maximum toll development and indirectly aiding local development as well. As an illustration, consider the hours from 9 a. m. to 4 p. m. as the high rate period, the hours from 4 p. m. to 8 p. m. and from 6 a. m. to 9 a. m. as the medium rate period, and the hours from 8 p. m. to 6 a. m. as the low rate period; possibly the medium rate might be introduced also between the hours of 12 noon and 2 p. m. One of the chief arguments which will be urged against such a plan is the increased auditing expense caused by the necessity for listing separately on the check ledgers the business in each rate period. When it is shown that the auditing expense is but a small percentage of the total expense of conducting the business, and when it is granted that the auditing expense may increase even as much as ten to fifteen per cent, it is obvious that the resulting net increase in total expense must be very small. The saving in auditing expense which accompanied an abolishment of night half-rates and the substitution of a single rate schedule in place of a double schedule did not, in one instance, equal ten per cent of the auditing expense. It is believed that the general principle of grading the toll rate will secure a maximum toll development, improve the load factor, simplify the matter of adjusting the operating force to the traffic load and produce the most uniform grade of service which it is possible to give.

The operating methods for handling toll traffic are exceedingly numerous, but they differ among themselves in only a few fundamental respects. It is not possible here to make an exhaustive analysis of these methods, but a summary will be given of their characteristic features. Traffic between points connected by direct circuits is commonly called terminal business and traffic between points not so connected is called through business; the latter is also called switched or relayed business, according to how it is handled at the switching offices. The principal methods are as follows:

I.—Direct ring-down, in-and-out ticket method. The operators signal each other by ringing on the toll circuit and pass calls and reports to each other over the circuit. They are without means of communication when the circuits are all busy, except via other routes. Each operator makes out a full ticket and the operator at the originating office establishes the connection, times it and supervises it.

II.—Morse ticket wire, in-and-out ticket method. In addition to the toll operators there are two "Morse" operators, one at each end of the toll circuit, who have a "Morse" circuit between them. All calls and reports are passed by "Morse." The toll circuits may be cleared by ringing, or ordered down by "Morse." The toll operators do not use the toll circuit for calls or reports; each operator makes a full ticket and the operator at the originating office times and supervises the connections. Communication between the toll operators is possible at all times by "Morse."

III.—Direct ring-down, outward ticket, double-track method. Requires at least two toll circuits and preferably more. The operators signal each other by ringing on the toll circuits. The circuits are divided into two groups, one for traffic in each direction. The inward operator makes no ticket or record whatever, but merely switches up the local line of the party called for to the toll circuit and cuts out until a clearing-out signal is received. The outward operator, at the originating office, deals directly with the party called for at the distant end of the toll circuit, makes out a full ticket, times the connection and supervises it.

IV.—Telephone order circuit, outward ticket, double-track method. Requires a group of circuits, preferably ten or a larger number, double tracked. An outward operator reaches an inward operator at the distant end of the toll circuits, over the order circuit and passes the distant local number wanted; this is obtained and assigned to an idle toll circuit by the inward operator, who advises the outward operator of the assignment so that she may take it up. The outward operator then deals direct with the distant party called for, establishes the connection, times it and supervises it.

Method I is used by companies which interchange business with other companies, the inward ticket being used by each auditor as a check upon the revenue statement of the other company. Wherever possible, however, the inward ticket should be abolished, or made out in only the briefest memorandum form, so as to economize in circuit use and operators' time.

Method II is designed to secure high circuit loads on toll circuits worked in small groups; it is not especially fast. It is unsuitable for short-haul business and can only be justified when the increased revenue from the higher circuit loads more than compensates for the expense of the "Morse" operators; this naturally implies moderate to long hauls, where the average revenue per message will be high. Method III is suitable for short-haul business wholly within the territory of any one company and will give superior operator loads over the previous methods. For very large volumes of traffic, method IV is preferable. Rigid division of a group of circuits into two parts for double-tracking purposes is inadvisable, especially in small groups. The larger the size of a group, the greater the efficiency of the individual circuits; that is, the higher circuit loads they will bear. Double-tracking may therefore reduce the maximum permissible circuit loads; this can be offset to some degree by making a flexible division, some of the circuits being reserved for use in either groups, as may be required at any moment. Suppose there are eight circuits, numbered from No. 1 to No. 8; the outward operator at one end may be instructed to commence the assignment of connections on No. 1 and proceed in order toward No. 8, the outward operator at the other end being instructed to commence assignments on No. 8 and proceed in reverse order toward No. 1, there being no rigid division of circuits into two groups. If traffic at any moment is heavy in one direction and light in the other, this method of double tracking lends itself readily to the temporary condition and maintains high average circuit efficiencies.

The foregoing methods are described as applicable to business between offices connected by direct circuits. When there is not sufficient traffic between two offices to warrant even one direct circuit, the business must be handled over a circuit built up through one or more intermediate offices, sometimes called a tandem circuit. At an intermediate office the operator connects an incoming toll circuit from the originating office to an outgoing toll circuit to the office desired or the next intermediate office en route. If the intermediate operator makes no ticket the connection is termed a straight switch, and if the operator makes out a through ticket the connection is termed a relay or ticket

switch. So far as possible through business should be handled on a straight switch basis, to economize both in circuit time and operators' time. At offices where the lines of two or more companies are switched together, switch tickets serve as a check upon the reports of the originating offices. Operating method No. I is most commonly employed for through business; Method No. II may be applicable in case an economical layout of ticket wires can be devised.

The choice of proper circuit loads, in terms of messages handled per circuit per day, is a matter which involves both the average speed of service and the load factor. This is a point of view which has not, perhaps, been previously advanced; but it is the purpose to show that this is the correct view and that any other view disregards the relation which exists between the revenue per circuit mile, the average speed of service and the load factor. The consequence of giving too fast a grade of service for a fixed rate, may be not only the cancelation of profits, but an actual net loss; on the other hand, the consequence of attempting to increase indefinitely the revenue per circuit mile, with a fixed rate, may so impair the speed of service as to cause serious congestion of traffic and loss of patronage. As regards the load factor, first, it will be conceded by all that the more even the load curve the more even will be the speed of service; that periods of suddenly changing demand cause uneven service. A large load factor corresponds to an even load curve without prominent peaks or abrupt changes of large magnitude; it corresponds therefore to an even grade of service as regards variations in speed, and the average speed of service (or average delay) will be as nearly as possible representative of all the service as a whole. A small load factor corresponds to an uneven load curve with prominent peaks and large, abrupt changes in demand; it corresponds therefore to an uneven grade of service, fast during the periods of small load and slow during the periods of heavy load, the average speed being very poorly representative of the service as a whole. It is submitted as a fundamental proposition that with a fixed average speed of service the circuit loads diminish as the load factor diminishes. It is also submitted as fundamental that with a fixed load factor the average speed of service diminishes as the circuit loads increase. Granting these, it follows that with fixed circuit loads the average speed of service diminishes as the load factor diminishes. There is an opportunity for considerable original investigation in determining the exact values of these relations, under different rate schedules, and different operating methods. The results of one such determination are given in Fig. 5, which expresses the relation between the circuit load per week day, Saturday excluded, and the average speed of service; the load

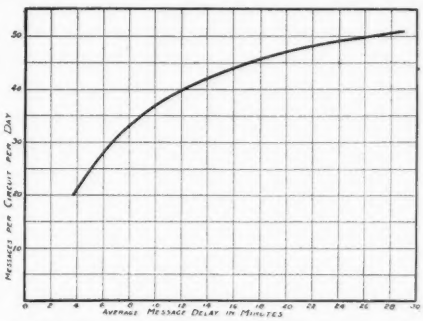


FIG. 5.—RELATION BETWEEN SPEED OF SERVICE AND CIRCUIT LOADS.

factor was approximately thirty per cent and the traffic was handled by operating method No. III.

Practically everyone is in agreement on the statement that for a fixed speed of service, and a fixed load factor, the circuit loads increase slightly as the number of circuits worked as one group between two given offices increases; in other words, the larger the group the higher the effi-

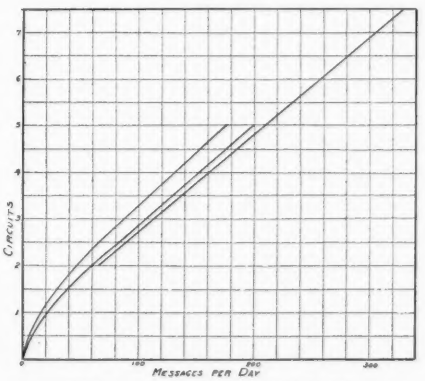


FIG. 6.—TOLL-CIRCUIT LOADS.

ciency of the individual circuits composing the group. Fig. 6 shows, in the form of curves, some circuit loads which will give fair service with a load factor of about thirty per cent; three curves are shown, one for each operating method except the fourth, which permits the same loads as the third. These loads are wholly on the basis of particular party business; two-number business will permit somewhat higher loads. Within the boundary of a zone whose telephones are not too numerous to be published readily in a single directory, the two-number basis is the most economical one, and should be used on all short haul, low-rate business. Very fast toll service implies low circuit loads and high rates, on the assumption that the business is profitable; and therefore it is contrary to the principle that a public service corporation should seek a maximum development. Extremely high circuit loads are equally to be avoided, because they imply very slow service, with consequent public dissatisfaction and loss of business.

Operator loads are quite secondary in importance to circuit loads, because the plant charges in a toll system are greatly in excess of the expense for operators' wages, and general economy depends upon securing proper and sufficient loads for the plant. This principle should be given special emphasis in the case of long-haul business. While it is important to keep toll operators busy, it is more important not to overload them. A toll operator who is given more toll circuits to handle than she can keep busy, will consequently delay business and impair circuit efficiencies, causing losses which exceed many times the saving in the wages of an extra operator during the heavy load period. The requirements of toll operating are much more severe than are those of local operating and a high average of intelligence and alertness among the operators is necessary. The training requisite to produce a competent toll operator extends over a period of nine months to a year, when the candidate has not had previous experience. The loads which toll operators can handle depend, therefore, to a degree, upon their length of service and consequent experience. It is nearly as important to maintain a high average length of employment among the operators as it is to distribute their loads properly. Specific loads for operators handling various classes of traffic must apply, therefore, to the average operator rather than to the individual; expert operators will do more, inexperienced or undertrained operators less. The following average loads are probably fair values:

TABLE OF OPERATOR LOADS—CALLS PER HOUR.

Operating Method.	Character of Call.	Direct Circuit.	Tandem Circuit. One Switch	Two Switches.	Three Switches.
I and II	Outward	12	10	8	6
I and II	Inward	12	11	10	8
III and IV	Outward	24	20	..	..
III and IV	Inward	60	60	..	..
I and II	Straight Switch Ticket	..	36	24	16
I and II	Switch	..	8	..	..

Recording operators, 30 to 40 calls per hour.

In handling long-haul traffic, the operators should be underloaded, on the basis

of the above figures, in order that advantage may be gained in obtaining high circuit loads. It is important, for the same reason, to choose operating methods that give high circuit loads rather than high operator loads, when for any reason the necessity arises for a compromise.

The general procedure of arranging the operating force to correspond with the traffic load is as follows: Compute from the traffic loads the necessary number of operators and supervisors to handle the entire traffic of the given office during each half-hour of the day. Next work out a schedule of operators' hours by cut-and-try methods until the curve or plot showing the number of operators at the switchboards agrees most nearly with the traffic load curve, as in Fig. 3. Due allowance should be made for absences, reliefs and vacations; and also for the force necessary to cover special positions, such as the chief operator's or manager's desk, the directory position, the rate position, the routing position, the information position, the delayed-call positions, the service-listening and supervisory positions, etc. In small offices these special positions can be grouped or bunched together; and in the very small offices there is, of course, no need for them.

[To be continued.]

A Laboratory for Public Service.

In the recent issue of the *Technology Review,* Arthur D. Little of Boston presents with remarkable clearness the value to the country of the new Research Laboratory of Applied Chemistry at the Massachusetts Institute of Technology. He shows that "although the resources of a country form the basis of its prosperity, this is, nevertheless, determined in the long run by the manner in which these resources are utilized, or, in other words, by the industrial efficiency of the means and methods of production. We have developed great transportation systems, we handle raw material on a titanic scale, we have applied machinery to the addressing of our letters and the sticking of the stamps, but it remains true none the less that with a few conspicuous exceptions our manufacturing operations are carried forward in trustful ignorance and disregard of many of the factors upon which real industrial efficiency depends. This is shown in the stupendous waste which accompanies the first crude preparation of the raw material; it is shown in the general absence of a true selective economy in the apportionment of that raw material among the different industries, and it is shown again, and yet again, in the losses which attend nearly every step in the progress of the raw material toward the finished product. One need only refer to the wastes which attend lumbering, or the growing of flax for seed, the making of coke in bee-hive ovens, and the failure to utilize the casein of skim milk as a high-grade food product, to realize vaguely something of what these initial losses are. The absence of proper selective economy in the adaptation of raw material to use is everywhere, as when our railroads use untreated ties and poles, when coal-tar is burned as fuel, crystal alum used for purifying water, or valuable publications printed on ground-wood papers. We are still polluting our streams with wool grease, still wondering whether we can make alcohol from waste molasses, still buying coal without reference to heating power, and paying sixty-five cents a gallon for cylinder oil.

"When wastes so obvious and so easily remedied are everywhere taking heavy toll of our manufacturers, it is not surprising that in all lines of productive effort subtile and elusive problems present themselves and still further lower our industrial efficiency. Steel rails break by thousands, trolley wires snap, boilers corrode, milk cans rust, unsightly bloom appears on leather, cloth is stained or tendered, paints fail to protect the metal underneath. In a large proportion of cases those who are confronted by the problem have neither the time, the training, nor the equipment required for its solution, and yet such problems and thousands of others far more complex upon their face must be solved if our industrial efficiency is to be brought to its proper level.

"No one at all conversant with the facts can doubt that our industrial salvation must be found in a closer alliance and co-operation between the scientific worker and the actual agencies of production. Such co-operation exists, as we are all beginning to learn, in Germany, and its results are evident throughout the world in the tremendous expansion of German industry. In our own country no agency has done more to supply the little leaven which may yet leaven the whole industrial lump than the Massachusetts Institute of Technology, and her graduates by hundreds are doing yeoman service in the development of our resources and the application of the scientific method to our practice. So far this is altogether as it should be, but in the present condition of our manufactures it is by no means enough. The time has come to bring the splendid scientific organization and equipment of the Institute to bear directly upon our industrial problems as an aggressive force working for their solution.

"Since all material is subject to chemical laws and its properties and behavior influenced or determined by these laws, it follows that a large number, probably by far the greater number, of our industrial problems are problems in applied chemistry. No better field for the initiation of work intended to be directly effective in its bearing upon industrial efficiency could therefore have been chosen by the Institute authorities than that of research in applied chemistry upon some basis which renders the results obtained immediately available to those responsible for the conduct of industrial affairs."

Omaha Plans Another Electrical Show.

The success of the first electrical show held in Omaha last May has influenced the electrical interests of Omaha and its neighbor, Council Bluffs, to organize a permanent exhibition company to hold electrical shows every year. The next show will be held at the Omaha Auditorium from May 6 to 15, inclusive. On January 9 the permanent organization was perfected. It is called the Omaha Electrical Show Company and will be incorporated with the following officers: George W. Johnston, president; A. G. Munro, vice-president; W. L. Burgess, secretary; J. R. Lehmer, treasurer; J. M. Gillan, manager.

The show held last May was a success even beyond the expectations of the men who promoted it, and with the experience of last year and the confidence which success always brings with it, these same Omaha men feel confident that they can far excel last year's show in every respect.

Last year the association was uncertain as to how much money it would be safe to spend on decorations, entertainment and music, but this spring everything will be undertaken on a much more elaborate plan, showing a comprehensive line of electrical devices, and high-class entertainment will be furnished during the ten days of the show. Several of the men interested in the organization are now visiting the big electrical show at Chicago. They expect to not only pick up pointers for the Omaha show but also to interest many of the leading manufacturers in their exhibition.

Pittsburg Section, American Institute of Electrical Engineers.

The regular monthly meeting of the Pittsburg Section of the American Institute of Electrical Engineers was held in the Carnegie Institute, Pittsburg, Pa., on January 12, W. Edgar Reed, chairman, presiding.

The meeting was preceded by a very enjoyable social dinner held at the University Club.

The subject of the evening was presented by William Hoopes, of the Aluminum Company of America, in an original paper entitled "Electric Furnaces," and was illustrated by means of lantern slides.

Mr. Hoopes' paper was of unusual merit and is a valuable contribution to the literature of the subject.

The iron and steel companies and kindred interests were well represented by prominent members and much interest was shown. The discussion was participated in by Prof. Fred Crabtree, of the Carnegie Technical Schools; W. S. Hadaway, of the Westinghouse Electric and Manufacturing Company; H. W. Fisher, of the Standard Underground Cable Company; Ernest H. Brown, of the Arizona-Idaho Copper Extraction Company; E. C. Edwards, of the Firth Sterling Steel Company, and H. W. Muller, of the Allegheny County Light Company.

The subject for the February meeting will be "Electric Signaling," an original paper by F. L. Howard, of the Union Switch and Signal Company.

Fort Wayne Section, American Institute of Electrical Engineers.

The fifth regular meeting of the Fort Wayne Section of the American Institute of Electrical Engineers was held on Thursday evening, January 14, in the rooms of the Fort Wayne Engineering and Manufacturing Company. The chair was occupied by the vice-chairman, J. J. Kline.

The paper of the evening was presented by L. D. Nordstrum, entitled "Some Considerations Involved in the Design of Direct-current Generators and Motors." Mr. Nordstrum took up this question at first from the standpoint of the technical features involved in the design of a new line of electrical machines or the redesign of an old line; then as regards the question of watts lost in the machine and the effect of the heat on the insulation. He next made a comparison of the weights of copper and iron in the machine and considered the cost for varying quantities of each, presenting curves showing the effect of the increase of copper and the increase of iron on the cost of the machine.

Those taking part in the discussions which followed were J. J. Kline, E. A. Barnes, J. V. Hunter, A. L. Hadley and J. H. Haberly.

New York Section, Illuminating Engineering Society.

The January meeting of the New York Section of the Illuminating Engineering Society took place in the Engineering Societies' Building on January 14, and was well attended. The election of section officers was held, the result being as follows: Chairman, E. L. Elliott; managers, J. J. Humphreys, Jr., and C. A. Littlefield; secretary, A. J. Marshall.

Two papers were presented on street lighting, one by Walter C. Allen, electrical engineer of the District of Columbia, and S. G. Rhodes, engineer of the New York Edison Company.

Mr. Allen's paper contained a short review of the street-lighting conditions in Europe. It was shown that the quantity of illumination and the appearance of the post differed widely as compared with this country. The important feature of the paper was the giving of results of a number of tests made by the Electrical Testing Laboratories of New York city. These tests were not made so much to compare different illuminants, but rather in order that definite information as to the results being obtained might be made available. They covered over twenty installations of various types of illuminants. In the discussion which followed Mr. Allen stated that the cost per year for the various illuminants was as follows: Arcs, $85; four-glower Nernst, $65; forty-candle-power Gem and tungsten lamps, $24; mantle naphtha lamps, $22.80; mantle gas lamps, $20.85.

The paper by S. G. Rhodes was confined to lighting by tungsten lamps. He described in detail four installations which had been completed in the city of New York. The lamps are used in connection with ornamental cast-iron posts and are supplied through an underground system. Discussion brought out the fact that the intrinsic brilliancy is a matter of considerable objection, and is in this case probably accentuated by the white porcelain reflector above the lamp.

The papers were discussed by Dr. A. H. Elliott, Prof. E. L. Elliott, A. J. Marshall, P. S. Millar, H. Thurston Owens and Henry Floy.

The Indiana Electric Light Association.

A special meeting of the Indiana Electric Light Association will be held at the Claypool Hotel, Indianapolis, January 26. It is understood that an immediate reason for the convention at this time is the public-utility commission bill now pending before the state Legislature, which, if passed, may be construed adversely to the electrical industries in Indiana.

The morning session of the day's business will be given over to a meeting of the executive and advisory committees. The afternoon session is to be opened with an address by the president, Thomas C. McReynolds, who is secretary and treasurer of the Kokomo, Marion and Western Electric Railway.

"The Effect of Public Utility Legislation" will be discussed by Henry L. Doherty of New York city. R. M. Cass of the Indianapolis Light and Heat Company will read a paper on "The Tungsten Lamp," and S. B. Hofft, of the Merchants' Heat and Light Company of Indianapolis, will present a paper on "District Heating from Central Stations."

The Indiana Electric Light Association was formed at a meeting of the representatives of fifty public-service corporations in the state, held at Indianapolis, November 28, 1908. Fred Leslie, manager of the Muncie Electric Light and Power Company, is secretary and treasurer of the association.

Central Electric Railway Association at Indianapolis.

The third annual meeting of the Central Electric Railway Association will be held at the Claypool Hotel, Indianapolis, Ind., January 28. Following the business session in the morning there will be a paper on "The Luminous-Arc Headlight," by W. S. Culver of Cincinnati, O. In the afternoon, preceding the election of officers and remarks by the president of the association, there will be two papers, one on "The Proper Inspection of Equipment," by W. E. Rolston, superintendent of power and shops of the Cleveland, Southwestern & Columbus Railway, of Elyria, O., and the other on "The Practicability of Light and Power from Electric-railway Transmission Circuits," by G. H. Kelsay, superintendent of power for the Indiana Union Traction Company, of Anderson, Ind. The annual meeting of the Central Electric Traffic Association will be held at the hotel January 27.

The Time-a-phone, a Novelty at the Electrical Show.

Almost hidden away in an unobtrusive position in a small booth on the east side of the Coliseum floor at the Chicago Electrical Show there is one of the distinct novelties of the exhibition. The casual observer would hardly notice, attached to a bit of green cord on one of the posts of the booth, a watchcase telephone receiver of not unusual construction. However, had he held the receiver to his ear, touching a button in the side, he would have heard a set of musical chimes strike the hour, then another set of double gongs give the quarters, and finally a high-pitched bell count the minutes after the last quarter for the precise time it happened then to be.

This interesting application of the telephone to the transmission of time signals is called the time-a-phone and is the invention of M. M. Wood, 815, 135 Adams Street, Chicago, who is also the inventor of a number of other novel and useful devices in the electrical and allied fields.

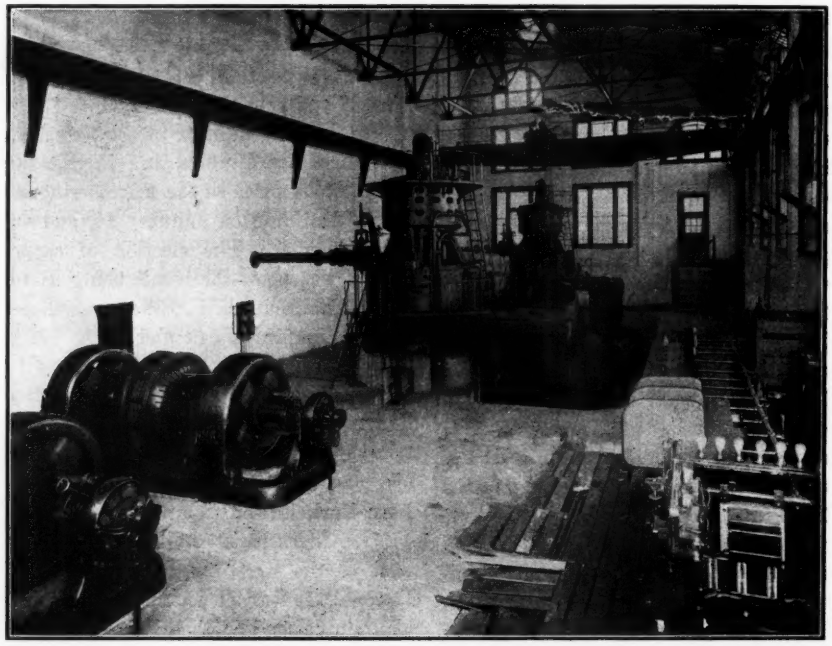
To a man in the dark the time-a-phone, operated as described, tells the time to the minute. From one master clock, say in a hotel, there may be connected any number of hand telephones attached to cords to be placed under the pillows in the bedrooms. By an arrangement of relays, when transmission is started to any receiver the other parties are automatically "locked out" until the signal is completed. Any master clock may be used to control the striking attachment. Connected to the clock shaft is an arrangement of cams which control the clappers, causing them to strike in the proper order gongs in front of a special transmitter which is in circuit with an ordinary induction coil whose secondary is connected to the respective instruments, at the pressure of the button. During the sending of a signal the cam system revolves once, making contacts to strike the proper hour. Although the strokes are given very clearly, if desired the signal can be repeated any number of times by pressing the button.

The useful nature of this time-telling device is evident, and its application to advantage in hotels, steamers, sleeping cars, dwellings and deaf institutes is clearly indicated. The patents on the invention were not secured until after the Electrical Show was already under way, and it was then only at the earnest solicitation of the show management that Mr. Wood agreed to a modest exhibition.

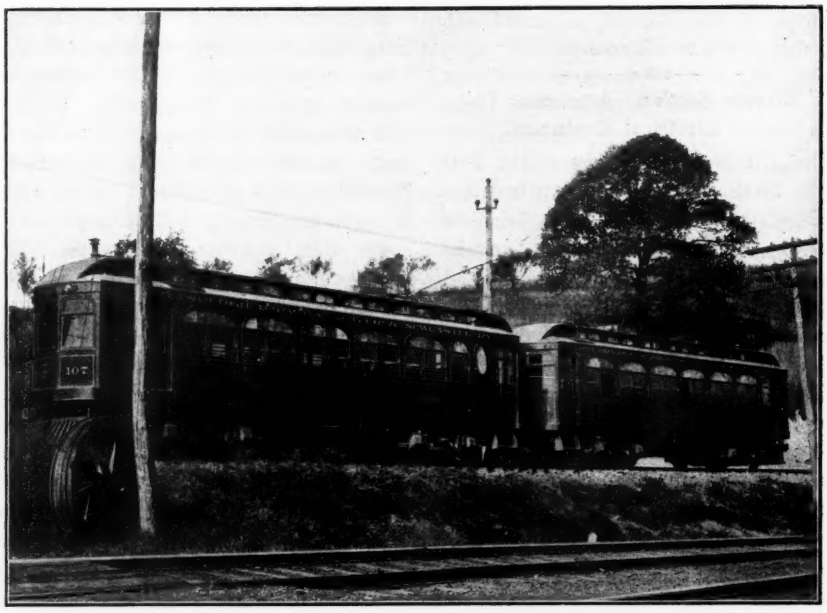
An Early 1,200-Volt Direct-Current Railway.

The recent inauguration of service on the Pittsburg, Harmony, Butler & New Castle Railway in Pennsylvania, brings to mind the fact that it is the pioneer road in the field of high-tension direct-current railway electrification. Although the Indianapolis & Louisville Railway was the first road in this country to use 1,200 volts on the trolley, the plans and specifications for the Pittsburg, Harmony, Butler & New Castle Railway were prepared at an earlier date, but have been only recently carried to completion.

Power is generated at Harmony Junction by two 1,500-kilowatt, three-phase, sixty-cycle, Curtis steam turbines of the vertical type, and transmitted at 13,200 volts to substations located at Shenango and Perrysville. The turbines are standard machines with two rows of buckets per stage and are equipped with mechanically operated valves and oil step bearings. They operate condensing, the usual vacuum obtained being twenty-eight-and-



INTERIOR OF POWER HOUSE AT HARMONY JUNCTION. PITTSBURG, HARMONY, BUTLER & NEW CASTLE RAILWAY.



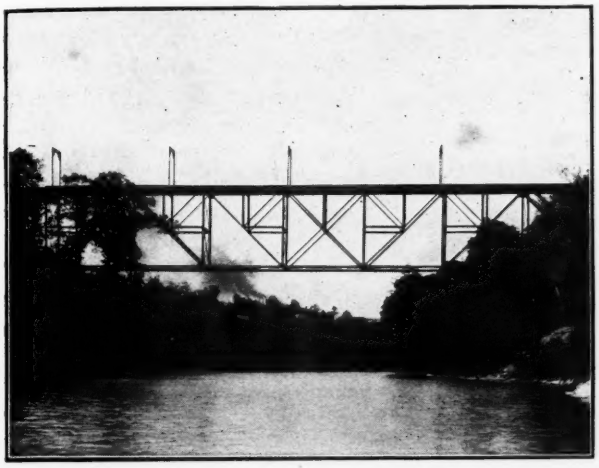
TWO-CAR TRAIN, PITTSBURG, HARMONY, BUTLER & NEW CASTLE RAILWAY.

one-fourth inches. In each of the substations there are two motor-generator sets, each set consisting of two 200-kilowatt, 600-volt, direct-current generators, direct-connected to a 425-kilowatt, 13,200-volt synchronous motor. The armatures of the two generators are connected in series, giving a trolley potential of 1,200 volts. A substation in the power house is similarly equipped and supplies both the Butler section and the central portion of the system.

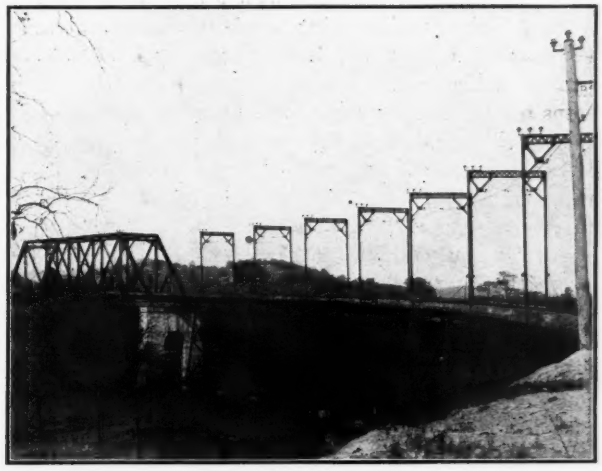
mutating-pole, 600-1,200-volt type, and are connected in two groups of two in series, this grouping being the same for both the 600 and 1,200-volt service. With the exception of extra insulation on the motor circuit, the control is practically the standard automatic form of type M control. Control connections are made so that should the motorman release the controller handle, power will be shut off the motors and the brakes applied. The brakes used are of the standard General Electric emergency straight-air type with a differential form of governor for multiple-unit operation. When the car is on the 1,200-volt trolley, current for lights and the air compressor and control circuits is furnished at 600 volts by a dynamotor.

eight per cent, although in the hilly country grades of five per cent are numerous.

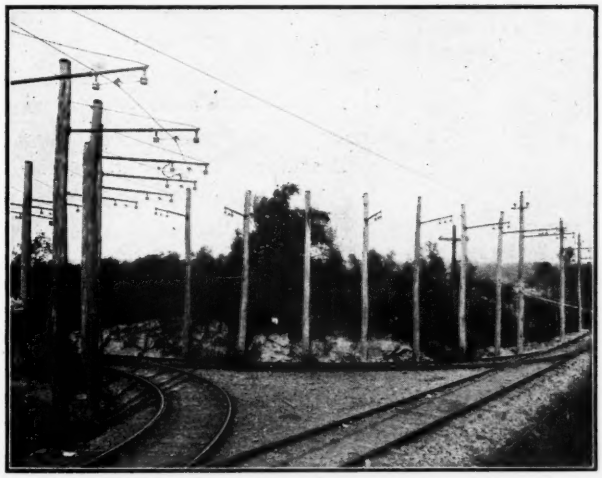
All the electrical apparatus used in the power house and substations and on the cars was furnished by the General Electric Company.



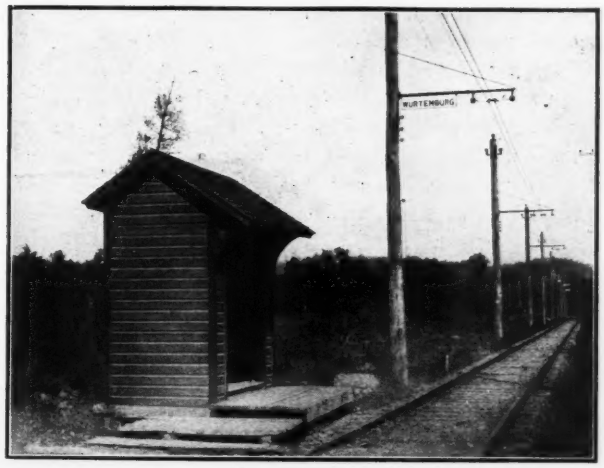
Grimm Bridge, Spanning Connoquonessing River.



Luntz's Bridge.



View of Ellwood City "Y."



Shelter at Wurtemburg.

VIEWS ON PITTSBURG, HARMONY, BUTLER & NEW CASTLE 1,200-VOLT DIRECT-CURRENT RAILWAY.

With the exception of four miles of 600-volt trolley on the city lines at the Pittsburg end, the entire railway system is operated at 1,200 volts. A grooved No. 0000 trolley wire is used, this being strung double the entire length of the road. There are at present fourteen four-motor passenger cars in use, although in the near future two cars for freight service will be put into operation.

The motors used on both the passenger and freight cars are of the GE 205 com-

There are sixty-five miles of single track, and at the Pittsburg end of the road double track is laid for eleven-and-one-half miles, eighty-pound standard rails being used. The maximum grade is

The Swatow, China, Lighting Plant.

Swatow is in the peculiar position of having an electric installation but no light. The undertaking which started so well a year or two ago is now closed down and the plant is lying idle. The Chinese company which owns it is averse to foreign capital being invested in the enterprise, with the result that all attempts of Europeans to obtain control of the undertaking have proved unavailing. When the company ceased working on the first occasion it was supplying some 1,700 lights. It was restarted and did very well until lightning struck a dynamo. Since then the works have been closed down, leaving Swatow without electric lights.

The Chicago Electric Club.

At the meeting of the Chicago Electric Club on Wednesday, January 13, Kempster B. Miller made a very interesting address on the subject of developments in telephony. Mr. Miller considers that there is a bright future for automatic and semi-automatic systems of effecting connections of subscribers' lines. Particularly in the larger cities will automatic service become more and more necessary as exchanges expand; and it has to be taken into account that automatic systems have demonstrated their utility and are being installed in increasing numbers. This conclusion must not lead by any means to the impression that the manual system will be entirely superseded, as it is hard to believe that, at least for a long time, the automatic system will prove advantageous in private-branch exchanges, and the latter employ more operators in New York and Chicago than are employed in the main exchanges.

Telegraphy is practically on the same basis today as it was ten or twenty years ago. There are means available, says Mr. Miller, for increasing the speed of the transmission of messages, but the adaptation of these means to existing lines has been slow. He believes that it will be possible in the near future to transmit messages over telegraph circuits at the rate of 1,000 words per minute.

Following the address by Mr. Miller, there was a rather general discussion, and Max W. Zabel brought up the point that in the operation of telephone systems a condition utterly unlike any that prevails in other industries obtains, in that as the number of customers of the service increases, the net profit per customer decreases. This led him to believe that it would be essential to establish semi-automatic methods which would eliminate to a great extent the necessity for having direct wires between the subscriber's instrument and the main exchanges, and would hasten the day when a large proportion—possibly eighty per cent—of the equipment now necessary to serve a telephone company's customers would not remain in idleness.

The meeting of the club on Wednesday, January 20, at the invitation of Homer Niesz, manager of the Electrical Trades Exposition Company, was held in the Coliseum, in connection with the Chicago Electrical Show, and a very interesting address was made by Lieutenant-Commander Witherspoon, of the United States Navy, whose subject was "The Use of Electricity in the Navy."

Chicago Lincoln Centennial Memorial Celebration.

Electrical interests of Chicago are actively represented in the Lincoln Memorial movement, the work of organization and raising funds being in the hands of a committee, the personnel of which is as follows:

H. W. Young, chairman, sales manager Central Electric Company; M. B. Austin, president, M. B. Austin & Company; Perry Boole, sales manager, Electric Appliance Company; W. H. Colman, assistant manager, General Electric Company; H. M. Frantz, manager, Johns-Manville Company; T. P. Gaylord, manager, Westinghouse Electric and Manufacturing Company; J. W. Gardner, manager, Allis-Chalmers Company; John F. Gilchrist, assistant to the president, Commonwealth Edison Company; C. A. S. Howlett, manager power apparatus sales department, Western Electric Company; F. A. Henderson, sales manager supply department, Western Electric Company; W. W. Merrill, manager, Chicago Fuse Wire and Manufacturing Company; Homer Niesz, manager, Chicago Electrical Show; E. J. Postel, E. E., Postel & Linn; H. H. Smith, sales manager, Diehl Manufacturing Company; James Wolff, manager, New York Insulated Wire Company; F. Woodmansee, E. E., Sargent & Lundy, and F. P. Vose, secretary, Electrical Trades Association.

It is expected that the work of the committee will result in a substantial representation and addition to the Lincoln Memorial fund.

General Electric Not in a Waterpower Trust.

Hinsdill Parsons, fourth vice-president of the General Electric Company, made the following statement, according to the New York *Sun*, at Schenectady, N. Y., on January 16, in reply to a reference to an alleged waterpower trust included in the special message to Congress:

"The General Electric Company is not a party to any trust to control waterpower, nor is it to any considerable extent interested in waterpower through ownership thereof. It is interested in the development of waterpower, as the latter affords a market for electrical apparatus, of which its manufactures largely consist.

"The General Electric Company has no interest with the Westinghouse company in the ownership or development of any waterpower, nor do the men named in the article shown me, in so far as I know, control any waterpower in the interests of the General Electric Company. I do not know of a single waterpower company controlled by the General Electric Company except the power at Schaghticoke (the Schenectady Power Company), all of which power is delivered to the Schenectady plant of the General Electric Company."

Rejuvenation of the Sons of Jove at the Chicago Electrical Show.

The Sons of Jove will hold a rejuvenation at the Chicago Electrical Show Wednesday evening, January 27, at 8 p. m. Many prominent electrical men from all over the country are expected for this event, which is expected to surpass anything of the kind previously attempted. The various committees under the direction of the Illinois statesman, William S. Taussig, have been hard at work for the past few weeks arranging details for the reception of visiting Jovians and the initiation of a large number of new candidates.

The headquarters of the Sons of Jove are located at the Electrical Appliance exhibit, where all Jovians are expected to register and secure tickets for the banquet which will follow the rejuvenation. Members of the committees will be in attendance at the headquarters to give information to those from out of the city.

Completion of Pennsylvania Railroad's East River Tunnels at Hand.

Within the next few weeks it is expected that the four tubes of the Pennsylvania Railroad tunnels under the East River, New York, between Manhattan and Long Island City, will be concreted for their entire length, cleaned out, and in readiness to turn over to the Pennsylvania Railroad for the laying of roadbeds, tracks and installing the electric equipment for operation.

Rapid progress is reported also on the tunnel work under Manhattan and on the tubes under the North River running from Manhattan to New Jersey. Two of the tunnel outlets in the big railroad yard in Long Island City are already completed, together with a concreted roadbed which runs for several hundred feet from the entrance to the tunnels.

Work on building the connecting links between the completed East River tubes and the terminal points in the railroad yard is being rushed, and it is predicted that the tunnels will be in readiness for operation by next year.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

CHICAGO CITY RAILWAY.

The Chicago City Railway Company's comparative statement of earnings for the eleven months ended December 31, 1908, shows as follows:

	1908.	1907.
Passenger earnings	$7,657,102	$7,460,702
Other income	160,876	101,992
Total	$7,817,978	$7,562,694
Operating expenses	5,472,585	5,293,886
Balance	$2,345,393	$2,268,808
Interest allowance	1,463,089	1,116,386
Net income	$ 882,303	$1,152,422

The city's share of net earnings of the City Railway Company for the fiscal year ending January 31 will fall short $160,000 of the amount paid in the previous year. Gross earnings have increased about $275,000, while net earnings have fallen off almost an equal amount.

From the balance is deducted interest allowance, which brings the net earnings to $882,303, from which the city will receive $485,267 for eleven months. For the corresponding period last year the city's share was $633,831.

The interest allowance of five per cent on the capital invested in rehabilitation, which is taken from gross earnings, is largely responsible for the falling off in net receipts. Operating expenses must be seventy per cent of gross, which for eleven months amounts to $5,472,585.

LONDON UNDERGROUND'S EARNINGS.

The Underground Electric Railways of London report gross earnings for the week ended January 2, 1909, as follows:

Company.	1909.	1908.
Bakerloo	£ 3,670	£3,250
Piccadilly	5,700	5,390
Hampstead	3,825	3,170
District	9,618	8,733
Tramways	4,433	4,966
Total	£27,246	£25,489

UNITED WIRELESS TELEGRAPH.

The United Wireless Telegraph Company has issued its annual financial statement as of November 30, 1908, which compares as follows:

ASSETS.

	1908.	1907.
Good will and pat. rights	$ 5,005,190	$ 500,000
Treas. stock, pfd. and com.	5,315,410	6,659,110
Stocks and bonds other wireless companies	14,128,610	12,459,263
Factory and equipment	25,997	23,405
Stations, boats and equip.	502,942	229,988
Furniture and fixtures	3,975	4,085
Cash accounts, receipts, inventories, etc.	294,183	241,612
Total	$25,272,219	$20,117,463

LIABILITIES.

Capital stock	$20,000,000	$20,000,000
Bills and accts. payable	15,556	117,463
Surplus	5,256,662	.....
Total	$25,272,219	$20,117,463

The items of patents and patent rights include patents and patent rights in wireless telegraphy, wireless telephony and the fog-phone.

The item of stocks and bonds includes stock that gives the company the control of the International Telegraph Construction Company and its factory, patents, etc.

The item of factories and equipments includes the factories at Jersey City and Seattle.

MEXICAN TELEPHONE AND TELEGRAPH.

The report of the Mexican Telephone and Telegraph Company for the month of November and nine months ended November 30 compares as follows:

MEXICAN CURRENCY.

	1908.	1907.
November gross	$ 33,128	$ 31,796
Expenses	17,612	17,356
November net	$ 15,516	$ 14,440
Five months gross	282,625	293,397
Expenses	155,706	159,197
Five months net	$126,919	$134,200
Five months construc. exp.	116,550	81,719
Subscribers	6,572	5,880

AMERICAN LIGHT AND TRACTION.

The American Light and Traction Company has issued its annual report for the year ended December 31, 1908, which compares as follows:

	1908.	1907.
†Earnings	$2,452,873	$2,236,261
Miscellan. earn., imp., etc.	270,191	226,897
Gross earnings	$2,723,064	$2,463,158
Expenses	45,000	36,563
Net earnings	*2,678,064	$2,426,595
Dividends	1,349,254	1,242,912
Surplus	$1,328,810	$1,183,683
Reconstruction reserve	681,000	681,000
Surplus	$ 647,810	$ 502,683

*After allowing for six per cent on the $14,236,200 preferred stock outstanding, the balance, $1,823,892, is equal to 24.2 per cent earned on the $7,516,900 common outstanding.

†Earned on stock of sub-companies owned.

The profit and loss account compares as follows:

	1908.	1907.
Previous surplus	$2,992,827	$2,490,144
Year's surplus	647,810	502,683
Total profit and loss sur.	$3,640,637	$2,992,827

UNITED RAILWAYS OF ST. LOUIS.

The United Railways of St. Louis report for December and twelve months ended December 31 compares as follows:

	1908.	1907.
December gross	$ 910,288	$ 870,002
Expenses	555,430	557,907
December net	$ 354,858	$ 312,095
Charges	233,866	231,494
December surplus	$ 120,992	$ 80,601
Twelve months gross	10,593,165	10,828,737
Expenses	6,737,461	7,043,882
Twelve months net	$ 3,855,704	$ 3,784,855
Charges	2,788,746	2,778,023
Twelve months surplus	$ 1,066,958	$ 1,006,832

Independents Offer Proposition to Give Chicago Toll Connections.

Through H. D. Critchfield, of Milwaukee, Wis., general counsel, the independent telephone companies have made an offer to the Chicago City Council committee on gas, oil and electric light to give Chicago toll connections with the independent telephone lines.

Mr. Critchfield asserted there are 1,700,000 Independent subscribers within a radius of 500 miles of Chicago, and most of them desire toll connections with Chicago. In addition, it was declared that within that radius there are fifteen cities with an aggregate population of 4,000,000. The application was signed by a number of prominent independent telephone operators, among them: E. H. Moulton, Minneapolis; A. C. Davis, Parkersburg, W. Va.; Manford Savage, Champaign, Ill.; E. B. Fisher, Grand Rapids, Mich.; Frank H. Woods, Lincoln, Neb.; Charles G. Cockerill, Sioux City, Iowa; J. G. Splane, Pittsburg, Pa., and Joseph B. Ware, Grand Rapids, Mich.

They ask that the Illinois Tunnel Company be compelled to give toll connections with the Independents and install 20,000 telephones in the business districts. Outside of that territory the Independents seek the right to give service to such subscribers as the tunnel company is unwilling to serve.

It was pointed out that the Illinois Tunnel Company has had its franchise for a number of years, but has failed to develop its telephone system, and is now asking two additional years in which it shall be required to install 20,000 telephones. The Independents further ask that the tunnel company shall not be given the right to sell to the Chicago Telephone Company.

Plan an Aero Show for New York.

Plans are now under way for an aeronautic exhibition in connection with the Hudson-Fulton celebration in New York next September. The Aero Club and the Aeronautic Society have appointed committees to co-operate with the committee of the commission, of which J. M. Beck is chairman. Brigadier-General Allen has given the committee the assurance that the government will enter a number of airships in the show.

It is probable that a feature of the exhibition will be balloon races and contests between machines of the heavier-than-air type.

Those having the affair in hand believe that the government's interest in commemorating the trip of Robert Fulton's steamboat up the Hudson will be such that several warships will take part in the marine parade, which is to be a feature of the celebration.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

PROGRESS OF THE TRAMWAY INDUSTRY IN ITALY.

The Minister of Public Works has just published an exhaustive report on railways, tramways and automobiles, covering the year 1906, from which the following tramway statistics are extracted: On December 31, 1906, there were in operation 327 lines, while on December 31, 1905, there existed only 307 lines. Of the twenty roads opened during 1906, some were built by companies already operating tramways and some by new companies. The total length of the lines in operation on December 31, 1906, was 4,215 kilometres, this being an increase of 196 kilometres over 1905. Of the new lines, over 142 kilometres are operated electrically. The various employes in 1906 numbered 17,732, this being an increase of 1,830 over the previous year. There was also a notable increase in rolling stock, namely, five electric locomotives and 343 cars of different types. The number of accidents was lamentably large, 139 persons having been killed and 2,166 injured during the year 1906.—*Translated and abstracted from L'Elettricista (Rome), November 15, 1908.*

PETROL-ELECTRIC AUTOCAR TRACTION.

Petrol-electric autocars have replaced steam locomotives on the Arad-Csanad Railway in Hungary, the lines of which are about 490 kilometres in length. The system in use was developed by the manager of the company. At first it was applied only to freight and local passenger trains, and later, in view of the favorable results obtained, it was extended to fast passenger trains. The introduction of the system was begun six years ago, and the traffic, which had been stationary during the preceding years, has greatly increased on account of the larger number of trains and reduced rates, which it has been possible to make. The equipment of the autocars consists of a vapor engine mounted on the same base as the dynamo, to which it is directly coupled. The dynamo feeds the series motors actuating the driving axles by means of gearing. A cooler for the circulating water, installed on the roof of the car, a series-parallel motor controller, a petroleum reservoir and the various controlling accessories complete the equipment. All the apparatus is installed at one end of the car in a cab two metres long on seventy-horsepower cars, and 1.60 metres long on forty-horsepower cars. On fast trains two men are in charge, an engine attendant and a conductor, on the other trains one man performs all services. The petrol-electric autocar possesses important advantages as regards starting and speed control over cars directly driven by vapor engines, which are used in some places, as the starting can be effected without shock and the speed may be varied within the widest limits. Furthermore, only one axle is acted upon in the direct engine drive, and only half of the adhesive weight is utilized. The weight of a mixed train of one autocar with a forty-horsepower Westinghouse generating set and two trailers is 27.3 tons and has a capacity of six tons of freight, ninety passengers and two employes. The trains, composed of an eighty-horsepower car and two trailers, run at a speed of fifty-five to sixty kilometres an hour and have a capacity of 134 passengers.—*Translated and abstracted from L'Electricien (Paris), December 19, 1908.*

SPARK LOSSES IN A CLOSED OSCILLATING CIRCUIT.

E. Jacob has investigated this subject by the aid of the oscillograph. The circuit on which experiments were carried out consisted of a condenser having a capacity of 0.0322 microfarad, a self-induction coil of 1,270 henrys without iron, the calculated period of the system being 1276×10^3 per second, a value from which the measurement of the oscillograms differed by only 0.5 per cent. The condenser was charged by an induction coil with a Wehnelt interrupter, and for the purpose of registering the current curves the measuring loop of the oscillograph was connected in shunt with the oscillating circuit between the spark gap and the condenser. The damping of the system was made as small as possible, as above indicated, in order to examine the losses in the spark gap—that is, the damping of the sparks. The resistance of the entire circuit was 19.81 ohms. In this circuit the damping effect of the sparks was examined with reference to: (a), spark length and current intensity; (b), electrode material (Zn, Sn, Sb, Bi, Pb, Fe, Cu, Al, Mg, C and brass); (c), the gas through which the sparks pass; (d), subdivision of the spark gap. The results obtained were as follows: With constant current intensity the damping effect of the sparks rises with increasing spark length, while with constant spark length it grows with decreasing current intensity. The electrode material affects the damping effect only in so far as a greater heat-conducting capacity of the material also causes a greater damping. The surrounding gas has the same influence. The damping increases with the subdivision of the spark gap. The phenomena were explained by the fact that the spark gap possesses the properties of a high-frequency current arc.—*Translated and abstracted from Physikalische Zeitschrift (Leipsic), January 1.*

THE FINANCIAL STATUS OF THE UNIVERSITY PROFESSOR.

The Carnegie Foundation for the Advancement of Teaching was instituted for the betterment of the calling of the teacher in the United States, the Dominion of Canada and Newfoundland. Its first purpose has been to establish an efficient system of retiring pensions for professors in the higher centres of learning. Up to May, 1908, sixty colleges and universities had been admitted to the benefits of its retiring allowance system, and 106 professors and eighteen widows of professors are already receiving allowances amounting in the aggregate to more than $185,000. A report recently drawn up contains an introduction by Dr. Henry S. Pritchett, president of the Foundation, which is the foreword to the presentation of a collection of statistics relating to the salaries of American professors and a comparison of the figures with those prevailing in Germany. The report is based mainly on information derived from 102 institutions in the United States and Canada which appropriate more than $45,000 annually for the total payment of salaries to their instructing staffs. These data indicate that in these institutions the salary of a full professor ranges from about $1,350

to $4,800 annually. The average is about $2,500. An examination of the figures for associate professors and assistants shows that an American who has taken a postgraduate course and prepared himself for the profession of higher teaching may hope to obtain $1,250 at the age of twenty-eight, $1,350 at the age of thirty-one, $2,250 at thirty-three, and $2,500 at thirty-five. The German professor may expect in time a far greater financial and social reward than his American colleague. He has, furthermore, a place of far greater security, and with full protection for his old age and for his wife and family. On the other hand, he has to go through a longer period of probation than the American before obtaining the coveted chair. A German who possesses such ability that he may expect in due time to become a full professor, and who prepares himself for university teaching, must expect to study until the age of thirty with no financial return; to study and teach as a *privat-docent* until nearly thirty-six, with an annual remuneration of less than $200, and to teach from thirty-six to forty-one with an annual remuneration of from $600 to $2,000, by which time he may become a full professor and will continue to receive his salary until his death.—*Abstracted from Nature (London), December 31.*

RECENT DEVELOPMENTS IN STREET LIGHTING IN BERLIN.

Dr. L. Bloch describes the new high-pressure gas lamps and flame-arc lamps which have been introduced for street lighting in Berlin, and makes a comparison with former methods of illumination. The measurements entailed in these comparisons were carried out by the testing department of the Berlin Electricity Works. After the adoption of upturned, high-pressure gas lamps the next improvement in street lighting by gas was the employment of inverted lamps, burning under ordinary pressure. Although no improvement in illumination over the upturned gas lamp was obtained, economies over upturned gas lighting were effected by the inverted gas lamps. The accompanying table shows a comparison of different methods of street lighting in Berlin.

A comparison of the earlier and present systems of lighting in the Koniggrätzer Strasse shows that the gas consumption per 100 square metres of street surface is 6.5 times the former value, while the mean horizontal illumination has increased eleven times. The amount of gas consumed per lux and per 100 square metres is about 1,000 cubic feet. Three years ago the ordinary direct-current arc lamp with pure carbons was the most widely used. Illumination with more powerful and economical flame-arc lamps with inclined carbons had been adopted for several streets, but it had, however, to be proved whether this system was practicable over long periods. The removal of several incidental defects now allows the latter type of lamp to operate very well, and there is no doubt at the present time of its giving, with careful maintenance, an extremely good street illumination. The firm of Siemens, however, has lately brought out the so-called "Alba" carbons, which contain a thick core in a thin covering of carbon. The core is made of a material that gives out an intense white light, and these carbons can be burned in the vertical position. The arc lamps needed for "Alba" carbons differ only slightly from those in which ordinary carbons are used. With the ordinary arc the maximum light is obtained from the highly glowing carbon points, while in the new flame-arc lamp the arc itself is practically exclusively the illuminating part, and is of a much greater length than when ordinary carbons are used. On account of the large carbon diameter, flame-arc lamps fitted with "Alba" carbons have the same burning life as can be obtained with the ordinary arc lamp. The distribution of light obtained from the new "Alba" lamp is the same as with the ordinary arc lamp, and a more even illumination can be obtained with a smaller height of suspension than with the flame-arc lamp with inclined carbons. A favorable output is obtained with the new carbons, not only with large currents, but even with currents as low as ten or six amperes.—*Abstracted from the Electrician (London), January 1.*

COMPARISON OF DIFFERENT METHODS OF STREET LIGHTING IN BERLIN.

Type of Lamp.	Measure or Calculation.	Height of Suspension.		Distance Apart of Lamps.		Street Width.		Street Surface per Lamp-post.		Consumption per Post per Hour.		Consumption per 100 Sq. M. of Street Surface per Hour.		Consumption per Lux and 100 Sq. M. of St. Surface per Hour.		Horizontal Illumination				
																Mean Lux.	Max. Lux.	Min. Lux.	Max. Min.
		M.	Ft.	M.	Ft.	M.	Ft.	Sq M.	Sq Ft.	L'res.	Cu. Ft.	L'res.	Cu. Ft.	L'res.	Cu Ft				
Gas Lighting—																			
Inverted high-press. lamps..	Meas.	5.5	18	40	132	36.6	121	732	7,832	2,400	84	328	11.4	19	0.66	17.3	123	1.7	72
	Meas.	5.5	18	42	139	28.3	94	600	6,420	2,400	84	400	14	22	0.77	18.0	99	1.9	52
Upturned ord. pres. lamps...	Calc.	3.5	11.5	28	92.5	28.3	94	400	4.280	250	8.75	62.5	2.2	39	1.4	1.6	11.1	0.25	44
Upturned high-pres. lamps...	Meas.	5.7	12.8	42	139	21	70	441	4.718	1,200	42	272	9.5	52	1.8	5.2	18.9	0.8	23.5
	Meas.	5.7	18.8	42	139	20.5	68	431	4,611	2,400	84	557	19.5	48	1.7	11.7	41	2.0	20.5
Inverted ord. pres. lamps...	Meas.	4.5	14.8	28	92.5	17	56	238	2,546	456	16	192	6.7	35	1.2	5.5	58	0.6	97
Elec. Light'g—																			
Arc lamps with ord. carbons..	Meas.	10	33	30	99	22	73	660	7,062	Watt hrs 825		Watt hrs. 125		Watt hrs. 18.4		6.8	11.1	2.6	4.3
Flame lamp with "Alba" carbons.....	Meas.	10	33	30	99	22	73	660	7,062	825		125		6.9		18.2	31.2	6.6	4.7
	Calc.	5.5	18	40	132	36.6	121	732	7,832	825		112		4.9		23.1	132	3 2.0	66
	Calc.	7	23	40	132	36.6	121	732	7,832	825		112		5.2		21.7	71.5	2.9	24.6
Flame lamps (inclined carbons).	Calc.	7	23	40	132	30.6	121	732	7,832	825		112		5.4		20.7	121.5	2.5	49
	Meas.	18	59	45	148	.....		3,040	38,948	4,400		120		6.5		18.8	82	1.3	63

PRESENT SITUATION OF THE ALUMINUM INDUSTRY.

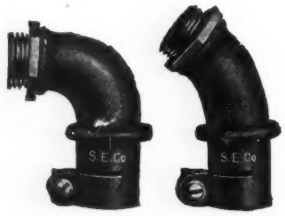
The *Chemiker Zeitung* declares that the present situation of the aluminum market is not at all satisfactory. The syndicate controlling this industry is said to be about to be dissolved, and if this should happen it would aggravate the condition still more. By maintaining a high price the syndicate in question has encouraged the establishment of a great number of aluminum factories, and consequently the supply of this metal is beginning to exceed the demand considerably. According to the journal mentioned the cost of manufacturing 100 kilogrammes of aluminum is at present 200 francs. In 1907 the selling price varied between 560 and 625 francs per 100 kilogrammes; in 1908 it fell to 175 to 180 francs, that is, below cost price. In 1907 the demand exceeded the supply on account of the great requirements of the automobile industry and heavy purchases of iron and steel foundries. Since then the orders of the automobile industry have fallen off and the steel works can now use a cheaper product of the electric furnace, ferro-silicium, which can replace aluminum with advantage. While the consumption has thus decreased the production has considerably increased on account of the establishment of new factories and on account of the fact that several patents have become public property. In 1906 the total production was 11,500 tons, of which 4,500 tons were manufactured in the United States and 3,000 tons in France. The present factories, on the other hand, are capable of an output of 37,000 tons. It is interesting to note that the selling price of aluminum per kilogramme has fallen from 1,250 francs in 1855 to 4.05 to five francs in 1907.—*Translated and abstracted from L'Electricien (Paris), December 26, 1908.*

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Steel Clamp Angle Box-Connectors for Cable or Conduit.

The accompanying illustrations show the new clamp angle box-connectors manufactured by the Sprague Electric Company, New York city. These connectors are made of stamped steel, are thoroughly galvanized, and are designed to be securely clamped to the armor by means of a single screw. Thus an effective ground is secured for the steel armor.



STEEL CLAMP ANGLE BOX-CONNECTORS FOR CABLE OR CONDUIT.

The connectors make it possible to lead the armored conductor or conduit into a box at an angle of forty-five degrees or ninety degrees, without straining either the armor or conductors.

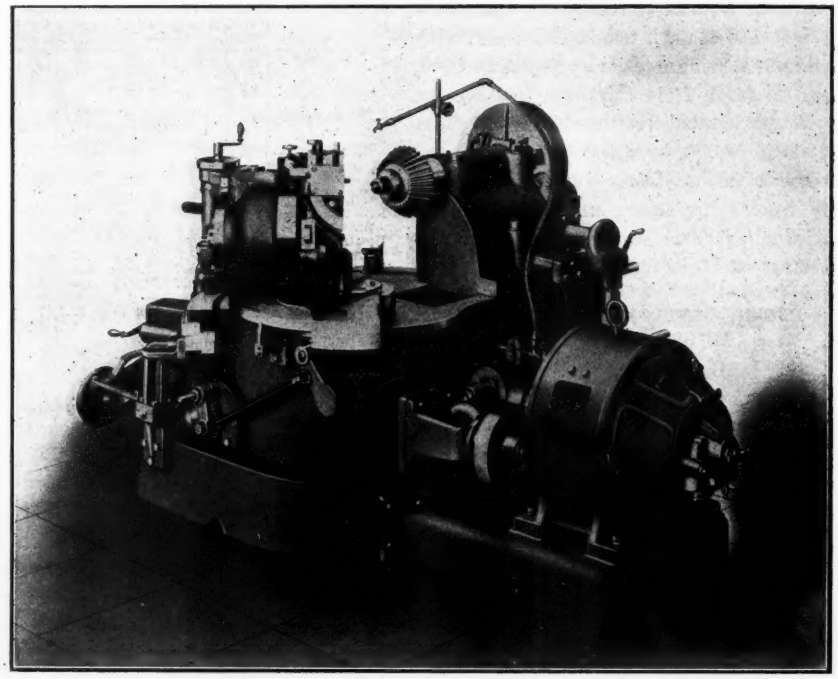
Electrically Driven Bevel-Gear Cutters.

The use of cut instead of cast gears has grown enormously within the last few years because of the demand for high-power gearings which shall run with a minimum of wear and noise. Correspondingly the machines which cut the gears have in this time been developed greatly to supply the heavy demand.

The illustration shows a compact and efficient machine, provided with an individual electric motor, for planing bevel gears of any angle, eight or more to one, and any size up to twenty-four inches in pitch diameter. This cutter is known as the twenty-four-inch automatic bevel-gear planer, and is manufactured by the Gleason Company, of Rochester, N. Y.

The machine will plane bevel gear teeth to cone lines. The curve tooth of the formers is produced by a machine which generates the curve. The resulting formers are absolutely correct, as the machines have been designed and built especially for this work. Three formers are necessary for cutting a gear; one for roughing, a second for the upper side of the teeth and a third for the under side of the teeth. These formers are in a revolving holder, so that they are brought into position successively without removal of one to give place to the next.

The gear to be cut is mounted on a horizontal spindle and adjusted by moving the head along the frame until the apex of the gear coincides with the centre of the machine. The arm on which the tool-holder travels is rotated around the centre of the machine in a horizontal plane. Besides this horizontal movement of the arm it is hinged at the centre of the machine so as to give a vertical movement as it is fed over the former. Thus the tool travels always at the correct angle of the gear, from the top of the tooth to the root, and the tooth therefore has the perfect reducing cut, the small end being in proportion to the large end.



GLEASON AUTOMATIC BEVEL-GEAR PLANER WITH MOTOR DRIVE.

The gear planer is driven by a standard constant-speed, shunt-wound Westinghouse five-and-one-half horsepower, enclosed type "S" motor, running at 1,135 revolutions per minute. This size of motor provides ample power to cut the largest size of gears for which the machine is designed. The motor is connected through a system of gearing to the planer, and, as shown in the illustration, is mounted on a base bolted to the standard base of the gear cutter. This provides a compact unit which is independent of all belts and shafts, so that it may be located at any point in the shop.

These gear planers are seldom worked continuously from morning to night, for in common with machine tools in general, their work is of a more or less intermittent character, with periods where the driving motor either runs light or may be shut down entirely. Motor drive effects a material saving in power because the machine takes power only in proportion to the work it turns out, and thereby reduces the cost of planing the gears to a minimum.

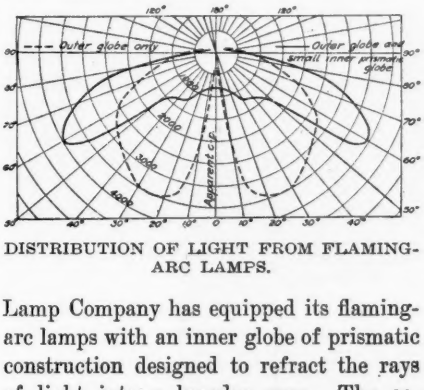
The Gleason Company also manufactures other sizes of gear planers and cutters, ranging from a capacity of fifteen inches up to 180 inches as a maximum, the one illustrated being the second in the series. On the smaller sizes a constant-speed motor is used, but for the four larger sizes an adjustable-speed motor with a speed range of two to one is recommended.

Prismatic Distributing Inner Globe for Flaming-Arc Lamp.

The well-known open-V arrangement of the carbons in the ordinary flaming-arc lamp, in which the highly luminous path of the electrical discharge is forcibly deflected from the lower vortex of the inclined electrodes, results in a downward distribution of the light, the maximum being obtained at an angle of about thirty degrees from the vertical. This downward distribution is satisfactory for producing an intense illumination over a small area directly below the lamp, but is not so effective for general street lighting.

NEW TYPE EXCELLO LAMP, SHOWING PRISMATIC INNER GLOBE.

In order to secure the desired horizontal distribution of the light the Excello Arc Lamp Company has equipped its flaming-arc lamps with an inner globe of prismatic construction designed to refract the rays of light into a broader cone. The accompanying illustration of the lamp shows the flaming arc enclosed in the prismatic inner globe. Of course the usual form of outer globe is used as on the ordinary lamp of the kind.



DISTRIBUTION OF LIGHT FROM FLAMING-ARC LAMPS.

For purposes of comparison of a lamp fitted with the inner refracting globe and one not so equipped a series of tests was carried out by the Electrical Testing Laboratories, New York city, for the Excello company. A ten-ampere direct-current lamp, with a positive electrode ten millimetres and a negative electrode nine millimetres in diameter was used. Two globe equipments were supplied; the first consisted of an eleven-inch clear-glass globe with ventilating ash tray at the bottom; the second consisted of a clear-glass eleven-inch globe with ventilating ash tray at the bottom and one of the new inner globes approximately five-and-one-half inches in diameter and four-and-three-quarters inches deep, having a two-and-one-eighth-inch aperture at the bottom.

The lamp was permitted to burn for about two hours before any tests were undertaken. It was operated upon one side of the three-wire system, the average line voltage being 118 volts. By means of an adjustable external resistance the current through the lamp was maintained at about 9.5 amperes. The light distribution was determined by means of the Matthews arc-lamp photometer having mirrors located at fifteen-degree intervals. The vertical plane throughout which the distribution was investigated is one located approximately at forty-five degrees to the vertical plane of the arc stream. In the photometric measurements a Bunsen photometer with Leeson disc was employed, and an incandescent electric lamp was used as the standard of candlepower. At each point at least 100 individual settings were made. The results shown below are average values obtained from a series of such settings:

DISTRIBUTION OF LIGHT.

Angle in Vertical Plane.	Flaming Arc with Clear Prismatic Inner and Clear Glass Outer Globes. Apparent Candlepower. Max.	Avg.	Min.	Flaming Arc with Clear Glass Outer Globe. Apparent Candlepower. Max.	Avg.	Min.
165	...	...	...	66	64	52
150	153	144	129	109	98	89
135	169	161	152	148	140	130
120	155	147	126	206	177	150
105	265	200	175	298	268	237
90 horiz.	548	440	300	732	638	528
75	3,320	2,735	2,140	1,665	1,505	1,400
60	4,870	3,970	3,240	2,890	2,585	2,435
45	1,656	1,404	1,136	3,140	3,005	2,640
30	1,384	1,212	1,028	3,745	3,460	2,490
15	964	861	735	3,515	3,240	2,900
0	943	836	748	280	248	210

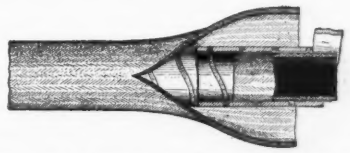
SUMMARY OF TEST RESULTS.

Amperes	9.5	9.5
Volts, line	118	118
Volts, terminal	57	58
Volts, arc	48	49
Watts	1,115	1,122
Watts, terminal	539	551
Watts, arc	454	465.5
Mean spherical cp.	1,135	1,122
Mean lower hemispherical cp.	2,120	2,285
Watts per m. s. cp. at term'l.	0.475	0.441
Watts per m. s. cp. at arc.	0.400	0.371
Watts per m. l. h. s. cp. at terminal	0.254	0.241
Watts per m. l. h. s. cp. at arc.	0.214	0.204

The results of light distribution, as shown in the table, are presented diagrammatically in the curve of light distribution, reproduced herewith. This shows graphically the difference in the distribution of the light from the lamp fitted with a prismatic inner globe as compared with the same lamp not thus equipped.

"Wireduct," a Non-Metallic Flexible Conduit.

"Wireduct," the new non-metallic flexible conduit manufactured by the American Conduit Manufacturing Company, Pittsburg, Pa., is distinctly different from other forms of flexible conduit. The inner tube of this conduit cannot be pulled out and it will not collapse under any circumstance, the manufacturer declares.



SECTION OF "WIREDUCT" FLEXIBLE CONDUIT.

Extreme torsion and severe abuse have no effect upon the tube. The bond between the middle tube and the fibre centre of the conduit makes the two literally one piece. This feature is quite new and the fibre, above mentioned, comprising the body of wireduct, is a special compound possessing great elasticity and tensile strength. At the same time it is of such a character as to blend readily with the other elements of the tube.

The tube is encased in an envelope of material which resembles the skin of the alligator in toughness and pliability and which will not deteriorate but is designed to retain its toughness and pliability.

The Schneider 'Firefly" Flasher at the Electrical Show.

One of the most pleasing effects at the Chicago Electrical Show which has received the admiration of all visitors to the Coliseum during the last week is the simulation of a star-lit sky studded with twinkling points of light, an illusion which is carried out with the use of dark bunting and over 1,000 delicately tinted two-candlepower lamps. The effect of twinkling has been secured by interposing in the individual lamp circuits "firefly" flashing sockets, the product of C. O. Schneider & Company, 103 State Street, Chicago. The flasher principle is entirely contained in the receptacle which carries the lamp.

Mr. Schneider was granted United States patent No. 908,679 on January 5, 1909, protecting the basic principle of thermostatic flashers. The application for this patent was filed August 13, 1904, and in the meantime as many as five other applicants have appeared at the Patent Office seeking to protect the same idea.

Exhibit of Electric Trucks at the New York Automobile Show.

An interesting section of the electric automobile exhibition at the Madison Square Garden Automobile Show in New York city, January 16-23, was that of the General Vehicle Company of New York. This company is the successor to the Vehicle Equipment Company, a pioneer in the commercial automobile field and the builder of a large percentage of electric power vehicles now in commercial service. Its exhibition space in the basement was filled with five of the seven sizes manufactured by the company, the smallest being a light electric delivery runabout with closed body having a capacity of 350 pounds load, a speed of fourteen miles per hour and a mileage of fifty miles travel on one charge of the battery. Standard models of electric delivery wagons of 1,000 and 2,000 pounds capacity were shown complete and ready for work. These have a radius of action of forty miles on one charge and a speed of ten to eleven miles per hour. A heavy trucking wagon of three-and-one-half tons capacity with stake body was also shown. This model has a mileage of thirty-five miles and a speed of seven miles per hour. A representative chassis of two tons capacity was shown which illustrated the general design of all models of the power-plant construction, the two-ton size having a radius of forty miles travel at eight-and-one-half miles per hour. In addition to the models exhibited the company also makes a five-ton truck.

The General Vehicle Company has a modern factory at Long Island City and is building a large proportion of the electric trucks and delivery wagons used in New York city. Its power vehicles are also in use in a majority of the large cities of the United States.

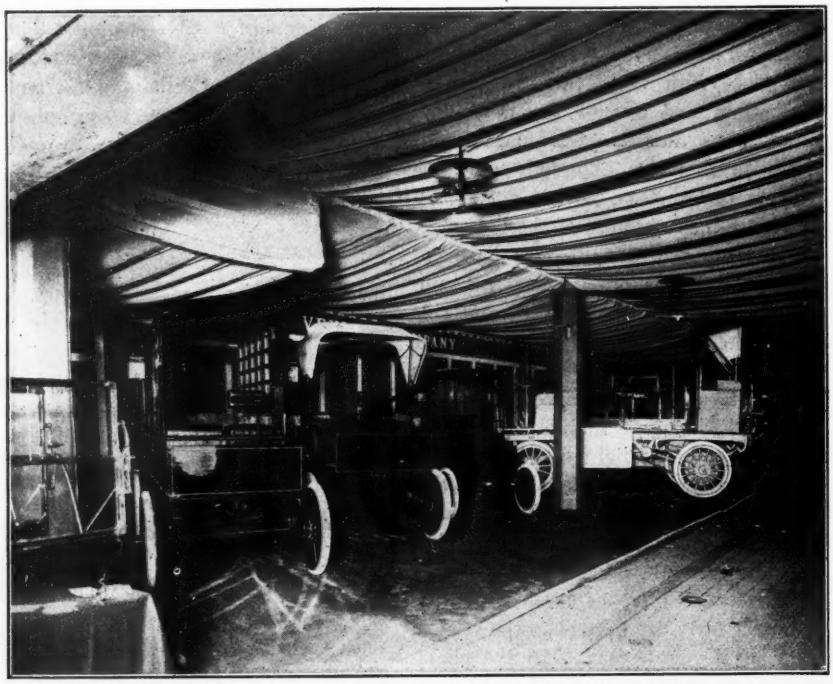


EXHIBIT OF THE GENERAL VEHICLE COMPANY AT THE AUTOMOBILE SHOW, MADISON SQUARE GARDEN, NEW YORK CITY, JANUARY 16-23.

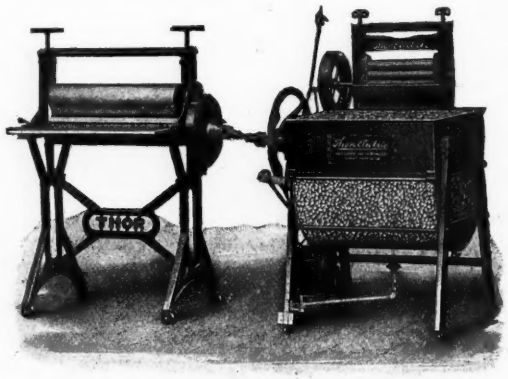
Electric Laundry Machine and General Utility Motor.

The use of the electric motor in the household is rapidly extending. Its great labor-saving qualities are being more and more appreciated by the busy housewife, as they were long ago appreciated by the industrious husbandman. One of the earliest and most useful applications of the motor to domestic ends has been its use in driving sewing machines. A field of probably still greater usefulness has been opened by its adaptation for reducing to a minimum the drudgery of laundry work. One of the accompanying illustrations shows that the family washing may be done automatically with comfort while attending to other household duties.

In this picture of a Thor electric washer and wringer the motor operates a very simple and effective washing machine, giving the perforated wooden cylinder which contains the clothes several rotations in one direction and then several in the reverse direction. The cylinder turns on its horizontal axis in a galvanized iron tub fitting its lower half and containing boiling suds. After the clothes are washed and simultaneously boiled, they are passed through the wringer at the top of the machine, which has three reversible rolls readily run by the same motor.

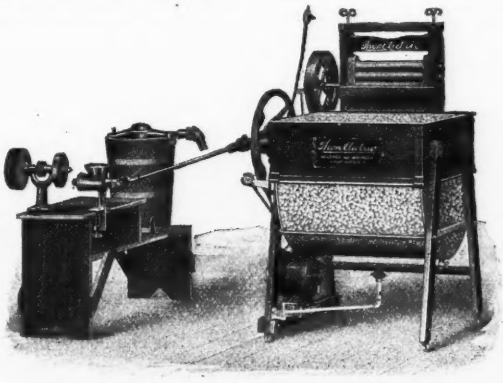
THOR ELECTRICALLY DRIVEN WASHER AND WRINGER.

For regular family use a machine having a revolving cylinder twenty inches long and of about the same diameter is used with a one-eighth-horsepower motor. For hotel use a machine of double this capacity has a cylinder twenty-three inches



THOR ELECTRICALLY-DRIVEN WASHER AND MANGLE.

in diameter and 25.75 inches in length; a one-sixth-horsepower motor suffices to operate it. Any kind of electric motor suitable for the circuit available is supplied. The motor is enclosed and mounted out of the way below the machine. It is connected to the cylinder through an automatic reverse gear which automatically operates the cylinder in alternate directions a definite number of turns. It is said that the cost of current to operate the machine for a family washing is but two to four cents.



APPLICATIONS OF THOR ELECTRICAL DRIVE TO WASHER, WRINGER, FREEZER, MEAT GRINDER AND CLEANING AND SHARPENING WHEELS.

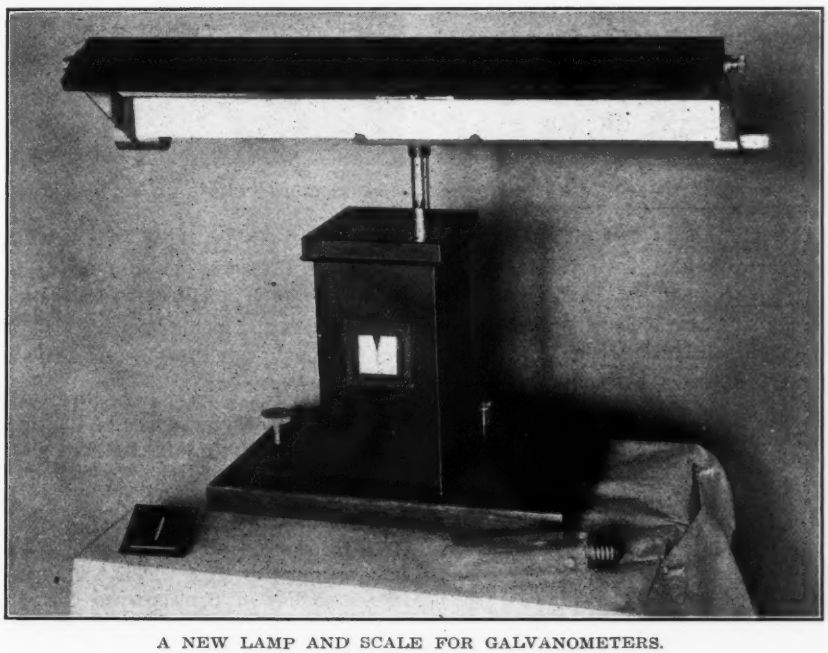
Besides its use for the washer and wringer the motor is serviceable for general household purposes. A universal joint that can be attached to the hub of the flywheel on the washer enables the motor to operate any standard ice-cream freezer, meat grinder, mangle, buffing wheel, polisher, etc. The two other pictures herewith illustrate some of these miscellaneous applications. These machines are made by the Hurley Machine Company, 153-159 South Jefferson Street, Chicago.

A New Lamp and Scale for Galvanometers.

A lamp and scale having several new features has been recently placed on the market and is now being extensively used. On account of its special construction it may be used equally well in a perfectly lighted room, or with no light but that contained in the instrument itself. This feature makes it especially desirable for use in wire factories and laboratories illuminated by daylight.

When used in daylight a straight filament lamp and narrow slot projector are used, which throws a brilliant white line on the scale. If used in a place too dark to read the scale without artificial illumination, a window of ground glass is introduced into the hood in place of the slot in conjunction with a special lamp to concentrate the light. This window has on it a black arrow and line which is projected on the scale. As seen in the illustration, the scale is thus brilliantly illuminated on both sides of the arrow, and the figures may be easily read, although the room is otherwise in perfect darkness. Every instrument is equipped with both outfits, which are easily interchangeable.

Another feature of this instrument is the construction of the reading device. In place of the ground glass scale usually employed, which makes at best a dull image, one of fine white cardboard on a mahogany back is substituted. The light falling on this makes a sharply defined image which the observer, standing behind the instrument, reads by means of a long adjustable mirror. With this scale the observer may stand to one side of the instrument and still be able to read as easily as if he were in front. The instrument is made by the Leeds and Northrup Company, of Philadelphia, Pa.

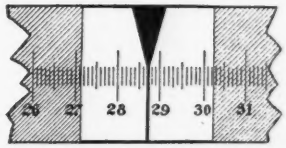


A NEW LAMP AND SCALE FOR GALVANOMETERS.

A New Pipe-Joint Cement.

Red and white lead and the ordinary pipe-joint cements on the market are sold ready mixed with either water or oil, and as a result the customer in buying these cements pays a high price per pound for the water or oil as well as for the cement proper.

To obviate this injustice the H. W. Johns-Manville Company of New York has recently placed on the market what is known as H-O pipe-joint cement. This cement is put up in powder form and can be kept in stock indefinitely, as it does not dry out or deteriorate. In using it the cement is mixed with either water or linseed oil, making it ready for use.



VIEW OF GALVANOMETER SCALE.

The chemical properties of H-O cement are such that it expands after the joint is made up, thereby making a perfectly tight joint. It does not harden as does red or white lead and the joint made with it can be easily broken at any time without danger of breaking the fittings.

The manufacturers assert that one pound of H-O cement mixed with water is equal to four pounds of the ordinary

ready-mixed cements, thus proving the economy of using this form. H-O cement has the additional advantage that it is not poisonous like lead cements and does not taint water.

Resources of Mysore State, India.

In a recent consular report Consul-General William H. Michael, of Calcutta, quotes from a recent address of the Dewan of Mysore State, India, to the representative assembly. Among other things, Mr. Michael says:

"The Cauvery power scheme, installed primarily to supply electric power to the Kolar gold fields, which also supplies lighting power to Bangalore, has proved a most useful and profitable investment. The net revenue from this source during the year was $500,853, which was a big return on the capital outlay. The gold mines have been equipped with up-to-date machinery, made possible by the electric energy supplied by the Cauvery plant, yielded, during 1907-8, $8,225,540, compared with $10,344,850 the previous year. The cause of this decrease is not satisfactorily explained, although assurance is given that the decrease in no sense is to be taken as indicating the exhaustion of the mines.

"The net earnings of the railway lines owned by the state amounted to $379,000, an increase of 4.71 per cent over those of the previous year. There are several tram and railway schemes under consideration, which, when carried out, will give the state good railway facilities for agriculture, manufactures, mineral, and passenger traffic.

"The government is taking great interest in the new Institute of Science founded by the late Mr. Tata, a merchant prince of Bombay. The government of Mysore appropriated $166,666 to aid in the construction of buildings for the institute, and has pledged itself to make an annual appropriation of $16,665 for its maintenance. The state expects to derive special benefit from the institute in the way of trained scientists and engineers for service in Mysore.

"The Institute of Science sent to the United States last year Prof. Norman Rudolph, who visited the leading universities and scientific institutions for the purpose of availing himself of the latest and best ideas, particularly in relation to laboratory work and apparatus. He has returned full of enthusiasm over what he learned, and the new institution will have no small amount of equipment designed and manufactured in the United States."

A Quick Restoration of Telephone Service.

In the issue of December 19 the Franklin (Pa.) *Evening News* gave unstinted praise to the Western Electric Company for the quick work it performed in installing a new switchboard in the Franklin exchange.

Early on the morning of November 17 the building in which the old exchange was located was totally destroyed by fire. When the local telephone officials saw that its old quarters were doomed an order was telegraphed to the Pittsburg house of the Western Electric Company to furnish the means by which the destroyed service could again be put in operation.

On the morning of November 19, two days after the order was sent, emergency boards, which Western Electric houses always have on hand, were received at

NEW SWITCHBOARD AT FRANKLIN, PA.

Franklin from Pittsburg. Meanwhile, when the Pittsburg house received the Franklin order, hurried specifications were sent to the manufacturing plant of the company at Hawthorne, Ill. To quote the *News:*

"With speed characteristic of the manner in which they do things at that plant, an express car of material was ready for delivery here by midnight of the day on which the emergency boards were received from Pittsburg.

"The rapidity with which the experts in the employ of the electrical company worked in the installing this material can be appreciated when it is known that on Sunday, November 29, twelve days after the fire, the installation of the new switchboard was completed and subscribers were being given a service, which, if anything, is superior to that given while the old switchboard was in operation."

A comparison is drawn by the *News* between the quick work performed on the Franklin switchboard and the record recently made by the Western Electric Company in furnishing the Central telephone exchange of Paris an operating switchboard in sixty days, while other electrical concerns throughout the world declared from four to six months would be required.

Alloys for Electrical Uses.

The British Thomson-Houston Company, in an English patent specification, discloses the composition of an alloy which has certain valuable properties adapting it to a wide range of uses. The invention is a communication from the General Electric Company, of Schenectady, N. Y. The alloy consists of sixty-two parts by weight of nickel, twenty of iron, thirteen of chromium and five of manganese. In the bottom of a clay-lined graphite crucible is placed an oxide to serve as a decarbonizer. The oxide is hemotite (Fe_2O_3). Nickel is then charged into the crucible with a small quantity of silica and cryolite flux. When the nickel is melted the heat is increased to promote a reaction between the oxide and the carbon. When the metal "quiets down," the carbon being eliminated, the iron is added, and after this is melted the chromium is added. While the mixture is still molten the manganese is added. The mixture is then quickly poured before the manganese attacks the clay lining. The alloy is stated to be refractory to an extraordinary degree, says the London *Times Engineering Supplement.* It resists the action of moisture and does not easily oxidize, even when subjected to a prolonged red heat in air. It has a high electrical resistance, adapting it for electrical heating and rheostat work. It is acid-proof, being insoluble in concentrated mineral acids.

Master Mechanics' and Car Builders' Conventions.

The conventions of the American Railway Master Mechanics' Association and the Master Car Builders' Association will be held in June at Atlantic City, N. J. The convention hall and exhibition spaces will be located on Young's Million Dollar Pier.

Arrangements are now being made to bring before the meetings a number of strong and timely papers.

Current Electrical News

CONTINENTAL EUROPE.

(Special Correspondence.)

PARIS, JANUARY 9.—An automatic telephone system is to be used for the first time in France, in the city of Lyons. The present outfit is a small one, and has been installed in the exchange in order to make a trial of the system, preparatory to adopting it on a larger scale should it prove to be satisfactory here. M. Simyan, the Postal Secretary, accompanied by the chief engineer of the Paris telephone department, and other officials, lately made a visit to Lyons to inaugurate the new service. The present apparatus has a capacity of 200 subscribers.

Among the new companies which have been formed on the Continent there may be mentioned the Spanish General Electric Company, organized to represent the English company of the same name. The headquarters of the new firm are located at Madrid. A newly formed Paris company is the firm of Eug. Belliol et Cie. It will undertake the manufacture and sale of electrical apparatus. The Société Electrique de la Barousse is another new company. Its headquarters are located at Toulouse. The Phebus Boiler Company has been organized in the north of France, at Cateau. Among changes in existing companies, I note that the Bergmann Company, which is now operating a large factory for manufacturing electrical apparatus in France, has increased its capital to $500,000. The Mors Electric Company is an offshoot of the well-known automobile firm of the same name, which is one of the largest in Paris. The electric company has lately increased its capital to $80,000. This factory is engaged in the manufacture of small apparatus, including wireless-telegraphy outfits on the Nachefort system. The Meximeinx Electric Company has changed its title to that of the Lyons Hydroelectric Company, and intends to operate a number of turbine plants in the eastern part of France.

Some time ago it was decided to adopt electric traction upon a portion of the Austrian state railroads, the work to be commenced on a number of certain short sections of the line in order to secure data for carrying out the electrification on a larger scale. The first of these sections extends from Trieste to Opcina, and current is to be supplied by a steam plant located in the city of Trieste. The same station is to furnish current for electric cranes and other motor-driven machines in the port of Trieste. The second section is that between Attnang and Irdning. Among other Austrian enterprises I may mention the construction of the Zabrech electric road, for which the rights were recently granted. It is to be a standard-gauge line. In the Tyrol region, the Nonsberg electric line is now being built, a considerable part having already been finished. There remain, however, a number of bridges of long span to be constructed.

Gas engines of the Körting suction type have been lately installed in a central station erected in the town of Godollo, Hungary. The engines and the rest of the outfit for this plant were furnished by the Ganz firm of Budapest. At present there are running two 150-horsepower gas engines, each of which is coupled to an alternator. The latter machines are of the three-phase type, and are designed to work at 3,100 volts. This power is used for the lighting supply of the town, being reduced to 105 volts by transformers.

An Italian manufacturing firm known as the Cotonifico Staurenghi has obtained the rights for a hydraulic plant, which will be located on the Evançon River. A 14-metre head of water is to be secured at this point, and the turbine plant will use 3,000 horsepower. The current is to be used for industrial purposes.

A. DE C.

GREAT BRITAIN.

(Special Correspondence.)

LONDON, JANUARY 8.—Trial trips are now being made over the section of the London, Brighton & South Coast Railway in London, which has been converted from steam to the single-phase system of electric traction. At present the only instance of single-phase traction in this country is that of the Midland Railway Company's system in the north of England, but it is expected that the line in London will be opened to the public in about three months. This section of line has a route mileage of about nine miles, which is equivalent to about twenty-three miles of single track. Among the many difficulties which have been encountered with low bridges, etc., in the erection of the overhead wires, has been the trouble with the roofs of the main terminal station at Victoria, to which the employes of the company must at all times have access. Consequently, in this station the conductors have been placed at a height of twenty-one feet, with the result that a special form of bow collector has had to be designed to meet these special conditions. The overhead conductors are half-an-inch in diameter, and are supported at every few feet from stranded steel catenary cables. These latter are, in turn, supported from porcelain insulators which have been tested to ten times the working pressure. Owing to the varying character of the bridges and other structures encountered, several forms of overhead construction have been used. In some cases this takes the form of girder arches covering both tracks, and in others single-arm brackets have been employed. In order to comply with the requirements of the Board of Trade and Greenwich Observatory, a duplicate feeding system has been provided. All the cables are now laid and most of the switching apparatus is in position. The overhead conductors are divided into sections at each station, where the various switching apparatus is placed in fireproof cabins. Power will be taken from the London Electric Supply Company, in whose power house at Deptford there have been erected four 2,000-kilowatt generating sets.

Official information published regarding the working of the London County Council conduit tramway system during the heavy snowstorm last week has revealed the fact that the large quantity of salt which was used by the local authorities for the purpose of melting the snow, in part found its way into the tramway conduits and caused a good deal of trouble. This probably accounted for the comparatively large number of fires which were reported by the daily papers as having taken place on the Council's cars during this period. But for this, the tramway service of the Council would have suffered less interruption than was the case with the various overhead systems throughout the country.

The announcement is made that the new wireless-telegraph station erected by the Post Office authorities at Bolt Head, in Devonshire (and of which some particulars were given recently in this column), has made communication with the station at Scheveningen, in Holland, a distance of 375 miles, although the normal range of the apparatus at Bolt Head is only 250 miles.

G.

WESTERN CANADA.

(Special Correspondence.)

WINNIPEG, JANUARY 17.—The much-talked-of meeting between the Winnipeg City Council and officials of the Winnipeg Electric Company was held in Winnipeg on the evening of January 16 and ended with the question no further along than it was a month ago. The purpose of the meeting was to receive an offer from the company for the disposal to the city of the electric street-railway system with its ninety miles of track, cars, equipment, etc., as well as the electric-light and power plant and gas plant, for all of which utilities the company holds a monopoly. D. D. Mann, vice-president, represented the company and informed the aldermen that while he was not in a position to speak without the consent of the directors, he was sure the company would not accept a price representing the valuation of the plant only, but would be willing to accept the figures of arbitrators or the value of the plant plus the value of the various franchises, an amount which, the company feels, is worth six per cent of the annual earnings. Taking the earnings of the company for the past year brings the price asked to over $19,000,000, while the figures for 1907 give a valuation of $16,645,000. The City Council is unanimously of the opinion the price is too high and unless the company makes another offer the deal will fall through and the city will immediately proceed with the construction of the power plant at Lac du Bonnet. At a meeting of the Power League, the day before the conference with D. D. Mann, a resolution was passed urging the city to sign at once the contracts for approximately $1,500,000 recently awarded, and call off all negotiations with the company.

Sealed tenders will be received by J. H. Trusdale, city clerk, Saskatoon, Sask., until February 3, for the supply of 500 horsepower in boilers in two or three units. Plans and specifications may be obtained from E. L. White, electrical superintendent at Saskatoon.

R.

IMPORTANT DEVELOPMENTS.

(Special Correspondence.)

MICHIGAN CENTRAL TO ELECTRIFY DETROIT TERMINAL AND CONNECTING MAIN LINE—Plans have been decided involving electrification of all the terminals at Detroit, and of the main line as far west as Ypsilanti, thirty miles from Detroit. It is planned to abolish local trains and use large electric cars for local business, having the steam trains stop only at the large cities. Electric power will be generated by a waterpower plant

to be built in the Huron River at Chelsea, Mich. The plans are said to contemplate the use of electric locomotives to draw trains from Ypsilanti into Detroit and through the tunnel now being built under the Detroit River.

DELAY IN SOUTHERN PACIFIC ELECTRIFICATION—Assistant General Manager Scott, of the Southern Pacific Railroad Company, who has charge of the conversion to electric power of the company's steam roads in Berkeley, Oakland and Alameda, announces that it will probably be two years before the system in Berkeley will be electrified and ready for operation. The Alameda system will be ready by the end of the present year. A.

POWER TRANSMISSION LINES IN NORTHERN CALIFORNIA—The Siskiyou Electric Light and Power Company will extend its line from Montague to Dunsmuir, and install another 1,500-horsepower generator at Fall Creek. The equipment has already been ordered for the installation. The company expects to have the extension completed by June 1. Seven miles of the new power line is being installed along the Klamath River for the mines of that section. The company is now supplying power for light to Ashland, Ore., and to Yreka, Montague, Ætna, Fort Jones, Klamathon, Lairds, Greenview and Dunsmuir, in northern California. The new extension will serve Gazelle, Edgewood, Weed, Sisson and Shasta Springs. The Siskiyou Electric Light and Power Company was recently reincorporated for $1,000,000. Alex. J. Rosborough, of Oakland, is secretary. A.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

DONIPHAN, MO.—The Farmers' Mutual Telephone Company will establish an exchange at Doniphan.

HURON, S. D.—F. H. Kent and others have been granted a franchise for a local telephone exchange at Huron. C.

PAWNEE, OKLA.—The Coal Creek Telephone Company has been incorporated by John Wolfe and others of Pawnee.

KEOKUK, IOWA—The Mississippi Valley Telephone Company, of Iowa, has increased its capital stock to $300,000. C.

AMITY, ARK.—The Cedar Point & Amity Telephone Company is being organized by local business men of Amity.

OROVILLE, CAL.—A franchise has been granted to J. H. Richardson for a telephone line from Richardson Springs to Chico. A.

CHILLICOTHE, MO.—The People's Telephone Company will rebuild its exchange and make other improvements to cost $40,000.

TULARE, CAL.—The Pacific Telegraph and Telephone Company has taken over the system of the Home Telephone Company in Tulare. A.

BROWERVILLE, MINN.—The Ward and Moran Telephone Company has been organized to build a rural line. Frank Haverik is secretary. P.

WAUPACA, WIS.—The Rural Telephone Company of Waupaca has been granted an amendment increasing its capital from $1,000 to $3,000.

HAYTI, S. D.—The Hamlin County Farmers' Telephone Company has been incorporated by Warren Green and others, with a capital of $25,000. P.

PIERRE, S. D.—A bill has been introduced in the Legislature to make the maximum rate for ten words by telegraph anywhere in the state at twenty cents. C.

ST. JOSEPH, WIS.—The Moulton Rural Telephone Company has been formed in St. Croix County, with a capital of $3,000, by C. M. Steindorf, J. E. Frawley and E. B. Nehder.

ST. PAUL, MINN.—The Northwestern Telephone Exchange Company has sent a check to the state treasury for over $50,000, being the three-per-cent gross earnings tax for the last year. C.

WELLINGTON, KAN.—The Missouri & Kansas Telephone Company has just completed a new and up-to-date telephone system for Wellington, at a cost of about $65,000. The switchboard, which is of the latest pattern, cost $15,000.

ST. PAUL, MINN.—Governor John A. Johnson, of Minnesota, recommends, in his message to the Legislature, a public utilities commission to supervise the affairs of the telephone and telegraph companies, and street and interurban railways. C.

HELENA, MONT.—The Montana Independent Telephone Company is installing automatic service and erecting a modern fireproof exchange building at Helena, and will have a new exchange in operation within sixty days at Deer Lodge. C.

RILEY, IND.—The Farmers' Independent Telephone Company, of Riley, has been incorporated with a capital stock of $1,000 to operate a telephone system in Vigo and Clay Counties; incorporators, Hartley Brill, William Clingman, Everett Fox, Henry Haas, W. J. Woodruff, Hale C. Jeffers and Charles Z. Adkins.

GRACEVILLE, MINN.—An independent company will be formed to install a telephone exchange at Graceville, following an attempt on the part of the present company to raise its rates. C.

DEVILS LAKE, N. D.—The Great Northern Railway is installing a telephone system for dispatching trains on the Minot division, from Devils Lake to Williston, a distance of 239 miles. C.

THIEF RIVER FALLS, MINN.—There is an agitation for municipal ownership of the local telephone exchange, complaint being made that the present company cannot give unlimited toll connections. C.

ST. PAUL, MINN.—According to Judge Hallam, of the District Court, house movers must guarantee telephone and telegraph companies adequate recompense before they cut or remove overhead wires. C.

ETNA MILLS, VA.—The King William Telephone and Telegraph Company, at a special meeting held in the office of Dr. J. A. Wright, has determined to extend its line to Richmond from Hanover Courthouse.

DORCHESTER, ILL.—The Dorchester Telephone Company has been incorporated with a capital of $1,875, to do a general telephone business. The incorporators are E. H. Taylor, Thomas Cody, Jr., and Charles R. Taylor. V.

WINDHAM, VT.—The Globe Mountain Telephone Company of West Townshend has been formed to build a farmers' line between West Townshend and Windham, by G. T. Gale, L. F. Jenson and twenty-two other subscribers.

SYDNEY, AUSTRALIA—A telephone switchboard is to be bought for the William Street Central in Sydney, New South Wales. The contract will be granted April 28, 1909, at the office of the Deputy Postmaster General, Sydney.

GOSHEN, IND.—The Flint Walling Company, of Kendallville, has secured the contract to construct the towers for the wireless telegraph system to be established between ports on Lake Michigan by the Great Lakes Radio-Telegraph Company. S.

COLUSA, CAL.—The entire business and equipment of the Pacific Telephone and Telegraph Company in Colusa County has been purchased by the Colusa County Telephone Company, the purchase price being in the neighborhood of $15,000. The new concern plans to rearrange the system. A.

MILWAUKEE, WIS.—The Wisconsin Telephone Company has completed the purchase of the telephone systems in Douglas, Burnett, Polk, St. Croix and Pierce counties from the former owner, the Northwestern Telephone Company of Minnesota. A sale of the properties was made necessary by the public utilities law, which provides that all companies operating a public utility in this state shall have their general offices within the state lines. The price paid is said to have been about $200,000. It is planned to rebuild completely the exchanges at Appleton and Janesville in the spring at a cost of about $150,000. New buildings will be put up and the central energy system installed. The improvements are expected to aggregate $1,000,000.

INDIANAPOLIS, IND.—Judge Parr of the Lebanon Circuit Court has made a ruling sustaining the demurrer of the Indianapolis Telephone Company to a complaint filed by the public prosecutor in the name of the state to enjoin the company from accepting the benefits of an amended franchise granted by the Board of Public Works. It was contended that the company was operating under a lease of the plant of the New Telephone Company, this lease being illegal and void under the statute. Judge Parr ruled that the statute confers on telephone companies in Indiana the power to become the lessors or lessees of telephone lines, exchanges, plants or systems of other companies. The ruling is one of importance to the Independent telephone systems in Indiana. S.

NEW PUBLICATIONS.

"INDUSTRIAL PROGRESS," a new monthly magazine devoted to the achievements of modern machinery, has made its initial appearance with a handsome January number of sixty-four pages. It is excellently illustrated with nearly fifty half-tone pictures and line drawings, chiefly the former. Among the leading articles are: "The Hydroelectric Development of the Great Northern Power Company, Duluth, Minn.," by Claude Aikens; "Electric Drive in Cement Mills," by R. B. Williamson; "Increased Economy in the Production of Steel," by C. A. Tupper, who describes in considerable detail the new immense plant of the Indiana Steel Company at Gary, Ind.; "Compound Corliss Engines," by S. Rice; "Machinery Used in Coal and Coke Operations;" a description of the York Run power plant of the H. C. Frick Coke Company, by W. R. Spillmire; and many other articles descriptive of electrical machinery, blowing engines, ore and rock crushers, cement-making machinery, flour-mill machines, gas and steam engines, hydraulic and steam turbines, pumping, mining and saw-mill machinery, etc., and typical installations where these various classes of machines are installed. The magazine is published by Industrial Progress, 330 Clinton Street, Milwaukee, Wis.

ELECTRIC LIGHTING.

(Special Correspondence.)

SARASOTA, FLA.—H. P. Porter will construct an electric-lighting system at Sarasota.

NEW RICHLAND, MINN.—Lea & Borge have sold their electric-light plant to Peter Breilein. C.

PARK RAPIDS, MINN.—H. L. Rice has been granted a franchise for an electric-lighting plant. P.

DANVILLE, ARK.—The Danville Electric Company has been incorporated with a capital stock of $10,000. P.

HUSUM, WASH.—N. A. Ingram is planning to install an electric-light plant at the new town of Lugon. P.

EUFAULA, OKLA.—The Pioneer Electric Power Company has been incorporated with a capital of $9,500.

FAIRFIELD, WASH.—An electric-light franchise has been granted to the Nixon-Kimmel Company, of Fairfield. A.

FOWLER, KAN.—R. B. Flesch & Company have been granted a franchise for an electric-light, water and ice plant.

EL DORADO, ARK.—The El Dorado Light and Water Company has been incorporated with a capital stock of $50,000.

BARTLESVILLE, OKLA.—The Bartlesville Electric Light Company contemplates the building of an addition to its plant. P.

REDWOOD CITY, CAL.—Bids are being received for constructing an extension of the municipal electric distributing system. A.

STOCKTON, CAL.—Bids will be received February 8 for a franchise to furnish electric power and light to the city of Stockton. A.

CENTER, TEX.—Felix Hubbard and S. T. Fleshman have purchased the business of the Center Electric Light and Power Company. P.

VERNON, TEX.—The Vernon Electric Light and Power Company has suffered a fire loss of $10,000. A new plant will be built at once. P.

SUMMERVILLE, TEX.—The Summerville Electric Light and Manufacturing Company has been incorporated with a capital stock of $10,000.

OAKLAND, NEB.—M. A. Drager, of Emerson, and R. H. Burton-Smith, of Sioux City, have submitted plans for remodeling the Oakland power plant. C.

PLACERVILLE, CAL.—W. P. Hyatt has appropriated 2,000 inches of water of the north fork of the Cosumnes River, to be used for power purposes. A.

BOCA, CAL.—The Union Ice Company has built another electric-light plant at Boca to replace the old plant which was burned down a short time ago. A.

GREENSBORO, N. C.—The Randolph Power Company has been incorporated with $100,000 capital stock by W. C. Petty, H. C. Petty and M. W. Parrish.

DICKINSON, N. D.—Hughes & Deiters contemplate enlarging their electric-lighting plant. An eighty-foot addition will be erected and two new boilers installed. C.

MODESTO, CAL.—The final ordinance perfecting the sale of a lighting franchise to the La Grange Light and Power Company has been passed by the City Council. A.

PARAGOULD, ARK.—A franchise has been granted to the Crystal Ice Company, of Paragould, to install an electric-light plant for lighting the streets of the town.

IOWA CITY, IOWA—The City Council has authorized City Clerk Slater to advertise for bids for wiring the city hall for electric lighting, not to include the fixtures.

ALLENTOWN, PA.—The Slatedale Electric Company has been chartered with a capital of $10,000, by Wilson Rex, president, and H. W. Bloss, secretary and treasurer.

KITTERY, ME.—The Automatic Electric Power Company, of Kittery, has been incorporated to supply water, gas and electricity. G. E. Burnham is president of the company.

SULPHUR, OKLA.—The Sulphur Light Company has been incorporated with $36,000 capital stock, by C. L. Patterson, Mangum; E. E. Preston, Oklahoma City, and J. F. McKeel, Ada.

WASHINGTON, D. C.—Representative Jenkins of Wisconsin has introduced a bill providing for the federal ownership of the electric and gas-lighting plants in the District of Columbia.

CHICAGO, ILL.—The Commonwealth Edison Company has acquired control of thirty acres adjoining former holdings on Center Street, for $191,500, as part of its plans for expansion.

GALENA, ILL.—Fire broke out in the Galena electric-lighting plant and caused damages to the amount of a few hundred dollars. The dynamos were covered with tarpaulins to protect them from the water, and are believed to be not seriously damaged.

GRAND SALINE, TEX.—The Grand Saline Light and Power Company has been incorporated with a capital stock of $10,000. P.

MOORHEAD, MINN.—The light and water commission of Moorhead has decided to reduce the rate for electric lighting eleven per cent. The plant made a profit of $16,000 last year. C.

VERGENNES, VT.—A bill pending in the Vermont Legislature authorizes the construction of a municipal electric-light plant and permits the city to issue bonds to the amount of $15,000.

SALEM, ORE.—The County Commissioners have granted the Portland Railway, Light and Power Company an electric-lighting and transmission franchise to the state school for the feeble-minded.

LEWISTON, IDAHO—F. J. Englehorn and K. G. Osterhout, of Nez Perce, have been granted an electric-light and power franchise in the town of Orofino, the work to commence without delay. A.

COQUILLE, ORE.—Seymour H. Bell has asked for an electric-light and power franchise in Coquille. It is understood that Mr. Bell will also make application for a franchise at Myrtle Point. A.

ELDORADO, ARK.—The Eldorado Light and Water Company has been incorporated with $50,000 capital stock. John Holmes is president; J. J. Hudson, vice-president, and S. R. Morgan, secretary-treasurer.

ST. PAUL, IND.—The Town Council is preparing to ask for bids for wiring the town for an electric-lighting system. The plan is to secure current from the Indianapolis & Cincinnati Traction Company. S.

FARGO, N. D.—An order has been received to the effect that every train on the main and branch lines of the Northern Pacific Railway System will be equipped with a modern electric-lighting system. C.

MAMMOTH SPRING, ARK.—The power plant of the Mammoth Spring Electric Light Company was totally destroyed by fire January 11. The plant was partially insured and will be rebuilt at once. B.

DANVILLE, ARK.—The Danville Electric Light Company has been incorporated with $100,000 capital stock. D. F. Montgomery is president; J. B. Grayton, vice-president; George Leming, secretary, and A. M. Falls, treasurer.

HUDSON CITY, N. J.—Central Avenue, Jersey City Heights, is to be brilliantly lighted with arches of incandescent lights, from Booraem Avenue to North Street, according to the plans of the Merchants' Co-operative Association.

FRESNO, CAL.—Manager Wishon, of the Fresno Light and Power Company, declares that the company will in the near future develop its lighting system for the distribution of power to the towns of Clovis, Sanger and Lemoore. A.

LA CROSSE, WIS.—The city has decided to spend $500 to bring an expert to La Crosse to decide upon the feasibility of operating a municipal light plant in connection with the waterworks. It would cost $45,000 to install such a plant.

ANN ARBOR, MICH.—The Edison Company has acquired all power and flowage rights on the Huron River. The company now has the power rights in Scio, Birkett and Dover, which gives it control of all the power in Washtenaw County. Eight dams will be erected between Ann Arbor and Base Lake.

EL CENTRO, CAL.—Three carloads of material have been received for the construction of the Holton Power Company's new turbine at Holtville, and eight carloads of machinery for the dynamo and the electrical equipment are now on the road. Excavation for the new power house has begun. A.

MARBLE FALLS, TEX.—The Granite Manufacturing Company, Dallas, Tex., of which C. M. Alexander is president, will build a waterpower electric plant at Marble Falls. The dam is to be of steel and concrete, sixteen feet high and 1,300 feet long. The present development will provide a forty-foot fall.

NEW YORK, N. Y.—In the report made by Chief Plan Clerk John F. Rush to Building Superintendent Murphy, it was shown that under the electric-sign ordinance that went into effect in May, 1907, permits for the erection of 1,340 signs were issued in the year, making the total to date in Manhattan 2,572.

LOS ANGELES, CAL.—The Edison Electric Company, it is said, is planning to tear down power house No. 1 in Mill Creek Canyon, the first in the world built to send power for long distance, the power being transmitted to Los Angeles. The old house will be replaced with a larger one, it is understood.

BRIDGEPORT, W. VA.—The village of Bridgeport is now ready to receive bids for lighting the streets. The present contract will expire next November, and at the last Council meeting George Koehnline was appointed a committee of one to secure prices and bids. The town is now paying $80 per light, and

the members of Council feel that they will be able to secure light at a lower rate. The matter of the town erecting its own lighting plant has apparently been dropped.

ALBANY, N. Y.—The Second District Public Service Commission has granted the application of the Babylon Electric Light Company for permission to construct and operate in the village of Farmingdale, Nassau County, and on certain roads in the county.

TACOMA, WASH.—At the recent election the voters decided in favor of the construction of a 20,000-horsepower hydroelectric plant and the issuance of bonds in the sum of $300,000 to pay the cost of preliminary engineering. The estimated cost of the plant is $2,000,000. A.

INDIANAPOLIS, IND.—The Legislature, now in session, is contemplating the construction of an electric-light plant in connection with the State House. The State is now paying $10,000 a year for electric lights for the Capitol building and the Soldiers' and Sailors' Monument. S.

ALLEGAIC, MICH.—Ensign Pickett, Edward O. Hanlon and a Mr. Clark have purchased the entire property of the Wayland Power and Light Company for $7,797.71, which was the amount of a trust mortgage and costs. The company supplies the village with light and power.

CRIVITZ, WIS.—The Northern Hydroelectric Power Company, of Green Bay, Wis., has let the contract for a dam and power plant across the Peshtigo River at High Falls, to the Bates-Rogers Construction Company, of Chicago. The entire cost will be nearly $1,000,000. C.

CHATTANOOGA, TENN.—The Lighting Company of Chattanooga has been granted a charter by the State of Tennessee. The capital stock is $10,000, with Messrs. A. A. McGregor, C. A. Lane, J. A. McGregor, Wallace C. Batham, T. B. Murray and Leroy McGregor as incorporators. B.

NEWCASTLE, IND.—The City Council is pleased with the municipal ownership of the electric light and water service, as shown by the report of an expert accountant. The report shows that the actual operating expenses of each of ninety-five street arc lights for the year was only $16.16, and even with improvements, both permanent and otherwise, the cost for each light was a little over $41.

BIG RAPIDS, MICH.—The board of supervisors has received the report of Prosecuting Attorney Joseph Barton, which declares that the franchise granted to the Grand Rapids-Muskegon Power Company, to use the Rogers Dam waterpower, expires April 1. For the company to attempt to use the waterpower after this date will be held illegal and it is declared the people of Mecosta County may begin proceedings.

MILWAUKEE, WIS.—William C. Quarles, attorney for Thomas J. Neacy, has been notified by the board of public works that bids for the construction of the municipal light plant will be opened February 17, and it is said that the injunction promised by Mr. Neacy will be served to stop the advertisements. Mr. Neacy's attorney was notified, according to the commissioners, so that a decision may be had as soon as possible.

KILBOURN, WIS.—Magnus Swenson, president of the Southwestern Power Company, declares that the Kilbourn dam will be in operation by April and that power will then be generated and sent to patrons. Milwaukee has contracted for 5,000 horsepower. When the local dam is fully completed it will generate 16,000 horsepower, and the Prairie du Sac dam will furnish 18,000 additional horsepower. The work of putting in the Prairie du Sac dam will be commenced as soon as the Kilbourn dam is finished.

PINE CITY, MINN.—Pine City will soon be furnished with electric power from the Snake River, where a power plant is in course of development. The promoters are J. M. Allen and R. P. Allen, of the Pine City Milling and Electric Company. The location of the plant is about seven miles east of Pine City. About 300 horsepower will be working by September 7, and the work will continue until the power, which will be 1,000 horsepower, is fully developed. It is estimated that it will take three years to complete the work.

PASADENA, CAL.—Pasadena is contemplating enlarging its municipal electric plant by buying the distributing system of the Edison Company. There has been a long fight between the city and the private corporation, and the latter seems now to have reached a point where it is ready to capitulate and sell to the municipality. A bond election is likely to be called to pass on the proposition of voting the money to make the purchase. At least $150,000 will be required for this purpose, making the total investment in the municipal plant $400,000.

CHICOPEE, MASS.—From the annual reports of the plant manager and municipal electric-lighting plant commission of Chicopee it is apparent that the commission and manager in 1908 made the best showing in the history of the plant. The report for the year ended November 30 shows a deficit of $459.01, as compared with $2,108.07 deficit in 1907. The expenditures are placed at $35,680.52, of which the heaviest items are as follows: Coal, $12,307.63; station wages, $5,018.56; distribution wages, $2,516.19; distribution expenses, $2,081.26; general salaries, $1,250; meters $1,439.05; jobbing account, $1,641.37.

BUFFALO, N. Y.—Complaint has been made by the Buffalo General Electric Company to the Public Service Commission against the Prudential Building Company because the latter supplies electricity to St. Paul's Cathedral and guild house. The complaint recites that the Prudential Building Company was incorporated for the purpose of dealing in real estate and building and managing an office building, and argues that it is discriminating to allow such a corporation to sell electricity without paying a franchise tax, for which privilege the complainant last year paid $30,000 to the city and is called upon to pay a tax this year of about $22,800.

NEW MANUFACTURING COMPANIES.

(Special Correspondence.)

McPHERSON, KAN.—The Anderson Electrical Company has been organized with a capital of $200,000, to manufacture telephones. P.

BUFFALO, N. Y.—The Patterson Sign and Electrical Company has been chartered with a capital stock of $10,000. Harold G. Peters heads the directors.

ALBANY, N. Y.—The Secret Party-Line Telephone Company, of Brooklyn, has been incorporated by R. Hamilton, E. F. Linton and J. R. Clark, to manufacture a patented article to secure privacy in the use of the telephone on party lines.

ALBANY, N. Y.—The Lyness & Malone Electrical Company has been formed by Arthur L. Lyness and John G. Malone, both former employes of the General Electric Company at Schenectady. Contracts will be undertaken at the office established at 31 Chapel Street.

NEW YORK, N. Y.—The United Tungsten Lamp Company, which has been incorporated to manufacture lamps and appliances, with a capital stock of $10,000, has the following shareholders: Thomas F. Farrell, Joseph J. Schmidt, Harry G. Anderson, 20 Broad Street, New York.

CHARLOTTE, N. C.—The Charlotte Machine Company has been granted a charter to manufacture and deal in electrical appliances, mill supplies and engines. The capital stock authorized is $2,000, all of which is paid in. The incorporators are F. J. Osborne, Thomas Costello and Albert M. Guillet. B.

SALT LAKE CITY, UTAH—The Simplex Manufacturing Company, which has filed articles of incorporation, has organized for the purpose of manufacturing electric apparatus and supplies; among other things is a telegraph transmitter recently invented by C. W. Leiser, an operator in the employ of the Western Union Telegraph Company, of Salt Lake City.

GRAND RAPIDS, MICH.—Articles of association have been filed by the C. J. Litscher Electric Company, organized for the purpose of engaging in the wholesale and retail electrical supply business. The capital stock is placed at $20,000, of which amout $10,500 is subscribed. The incorporators are headed by J. M. Louden and C. J. Litscher, of Grand Rapids.

BINGHAMTON, N. Y.—The Reliable Novelty and Electric Company has been organized by local capitalists to handle the electric motor recently invented by Ward Decker, of Binghamton. A manufacturing plant has been established in Lanesboro, Pa., which may be moved to Binghamton when the new company is thoroughly organized. Offices will be opened in Binghamton within the near future.

PROPOSALS.

POST OFFICE AT GREENVILLE, MISS.—The office of the Supervising Architect, Washington, D. C., will receive sealed proposals until February 18 for the construction, complete, of the United States Post Office at Greenville, Miss., in accordance with drawings and specifications, which may be had at the office of the postmaster at Greenville or at the office of the Supervising Architect.

PRODUCER-GAS ELECTRIC-LIGHTING PLANT FOR MILWAUKEE, WIS.—Sealed proposals will be received at the office of the Board of Public Works, Milwaukee, until February 17 for furnishing and erecting complete in running order ready for use, in buildings and on foundations to be furnished by the city of Milwaukee, all the machinery and appurtenances thereto, necessary to make a complete installation of a gas producer and a gas engine electric-lighting plant. The work to be completed within ten months from the date of the award of the contract.

UNITED STATES POST OFFICES AT BAR HARBOR, ME., AND SALISBURY, N. C.—The office of the Supervising Architect, Washington, D. C., will receive sealed proposals until February 17 for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the United States post offices at Bar Harbor, Me., and Salisbury, N. C., in accordance with specifications, which may be had from the custodians of the respective sites or at the office of the Supervising Architect.

PERSONAL MENTION.

MR. MORRIS W. STROUD, president of the American Gas Company, has been elected a director of the American Railways Company.

MR. ALBERT H. STANLEY, general manager of the London Underground Railroads, is in New York city to study the local transportation systems.

MR. A. E. MORRISON, formerly superintendent of the government telephone system in the province of Alberta, Canada, has accepted a position with the Shock & Hayloader Company, Minneapolis, Minn. R.

PROF. ABBOTT LAWRENCE LOWELL, professor of the science of government at Harvard College, Cambridge, Mass., has been appointed to succeed the retiring president, Charles W. Eliot, as the head of the college. Professor Lowell is fifty-three years of age and a brother of Percival Lowell, the well-known director of the Flagstaff, Ariz., observatory.

MR. E. T. MUNGER, former superintendent of motive power and equipment of the Metropolitan West Side Elevated Railroad, of Chicago, has been made general superintendent of the Hudson Tunnel System. Mr. Munger is a graduate of the University of Wisconsin of the class of 1892. He served the Chicago elevated from 1894 to 1898, and re-entered its service in 1903, after five years' service on electric traction lines.

MR. LOUIS J. AUERBACHER, manager of the electrical department of Fox Bros. & Company, New York, importers of the Polar flaming arc and Radiante lamps, made by the Carbone Licht-Gesellschaft, Berlin, Germany, was in Chicago last week to attend the opening of the electrical show and look after the exhibit of F. B. Badt & Company, its western agents. Mr. Auerbacher reports business booming.

MR. EDWARD C. BROWN, manager for the Dearborn Drug and Chemical Works of its Hawaiian office at 42 Queen Street, Honolulu, is making an extensive oriental trip of three or four months, during which he will visit Japan, the important sea-coast cities of China, the Philippines, Java, Australia and other important islands in the Pacific Ocean. Mr. Brown has most successfully handled the Dearborn company's business in the Hawaiian Islands since that department was opened, some ten years ago.

MR. GEORGE B. TRIPP, former business manager of the Central Colorado Power Company, whose appointment as general manager of the Empire Power and Water Company, of Colorado Springs, Colo., has been announced, has also been appointed general manager of the other affiliated companies controlled by George T. Bullock, of New York. These include the Colorado Springs Electric Company, the Colorado Light and Power Company and the Pike's Peak Hydroelectric Company. Mr. E. P. Dillon, who has been acting manager of these three companies for nearly a year, will accept a position with a large eastern concern.

MR. L. H. CONKLIN, the new general manager of the Scranton (Pa.) Electric Company, was graduated from Pratt Institute, Brooklyn, N. Y., in 1891. After several years spent working in various factories and plants, gaining practical experience, in 1894 he became an expert for the Excelsior Electric Company, manufacturing the arc machines designed by the well-known inventor, Mr. William Hockhousen, whom he served as chief assistant, with the title of assistant superintendent of the factory. From 1896 to 1900 Mr. Conklin was superintendent of the electric plant of the Flatbush Gas Company of Brooklyn, N. Y., whose territory included an extensive suburban district. During this connection he remodeled the system and put the company on a paying basis for the first time. Until 1904 he was associated in an engineering and contracting business in New York city under the firm name of Weiderman & Conklin. This business was successful and is still being conducted. In the spring of 1905 Mr. Conklin entered the employ of Mr. A. M. Young, prominently connected with a number of eastern electrical enterprises, as his engineer in the New England territory, rebuilding and modernizing several electric-light plants and building a trolley road. In 1907 Mr. Conklin came with the West Penn Electric Company, of Pittsburg, Pa., as superintendent of lighting, and in August of the same year was made general superintendent of the West Penn Railways Company, the West Penn Electric Company, the Pittsburg, McKeesport & Greensburg Railway Company, the Westmoreland Light, Heat and Power Company and the Latrobe Street Railway Company, constituting what is known as the West Penn System, operating the railways and lighting most of the towns in the counties of Fayette, Westmoreland, Allegheny and Washington. This position he has now resigned to become general manager of the Scranton Electric Company. Mr. Conklin is a member of the American Institute of Electrical Engineers, and president of the Pennsylvania Electric Association, of which he was the organizer.

ELECTRICAL SECURITIES.

Things have continued to show steady improvement and this has been reflected in an increase in activity in the stock market. Speculative sentiment has been of a most hopeful nature, and the growth of bank reserves has helped to add strength to the situation. An adverse factor was the report of the American Car Association on idle equipment on the country's railroads, showing an increase of 110,942 cars in the fortnight ending January 6. While this is not unusual at this time of the year it is, notwithstanding, unfortunate that the number of idle cars is now as great as it was last July.

Dividends have been declared upon the following electrical securities: Electric Company of America; regular semiannual dividend of three-and-one-half per cent, payable February 3 to stock of record January 20. Grand Rapids Railway Company; regular quarterly dividend of one-and-one-fourth per cent on the preferred stock, payable February 1 to stock of record January 15. Milwaukee Electric Railway and Light Company; regular quarterly dividend of one-and-one-half per cent on the preferred stock, payable January 31 to stock of record January 20. Montana Independent Telephone Company; quarterly dividend of one per cent, payable February 1. Commonwealth Edison Company; regular quarterly dividend of one-and-one-half per cent, payable February 1 to stock of record January 20. Manhattan Electrical Supply Company; regular semiannual dividends of three per cent on the preferred and three per cent on the common stock, payable February 2. Havana Electric Railway Company; an initial dividend of one per cent on the common stock and the regular quarterly dividend of one-and-one-half per cent on the preferred stock, both payable February 15 to stock of record January 23. Jacksonville Electric; $3 on the common stock, payable February 1; also semiannual dividend of $3 on the preferred, payable February 1. Montreal Street Railway; two-and-one-half per cent (quarterly), payable February 1. Albany Home Telephone Company; quarterly dividend of one per cent, payable January 20. American District Telegraph Company, of New Jersey; regular quarterly dividend of one per cent, payable January 22.

ELECTRICAL SECURITIES FOR THE WEEK ENDED JANUARY 16.

New York:	*Closing.*
Allis-Chalmers common	14½
Allis-Chalmers preferred	45½
American Tel. and Tel. Company	126
Brooklyn Rapid Transit	68
General Electric	154¼
Interborough-Metropolitan common	15⅛
Interborough-Metropolitan preferred	43⅛
Kings County Electric	125
Mackay Companies (Postal Telegraph and Cable) common	73½
Mackay Companies (Postal Telegraph and Cable) preferred	69½
Manhattan Elevated	149
Metropolitan Street Railway	28
New York and New Jersey Telephone	110
Western Union	66½
Westinghouse Manufacturing Company	79

American Telephone and Telegraph Company convertible four per cent bonds due 1936 have been admitted to quotation on the New York Stock Exchange.

The Interborough Rapid Transit Company for December showed a gross increase per day averaging $8,500, eighty per cent of which is net.

Boston:	*Closing.*
Edison Electric Illuminating	249
Massachusetts Electric	59½
New England Telephone	130½
Western Telephone and Telegraph pref.	80
Philadelphia:	*Closing.*
Electric Company of America	11
Electric Storage Battery common	43½
Electric Storage Battery preferred	43½
Philadelphia Electric	11½
Philadelphia Rapid Transit	25⅝
United Gas Improvement	91½
Chicago:	*Closing.*
Chicago Telephone	128
Commonwealth Edison	107½
Metropolitan Elevated preferred	46
National Carbon common	82
National Carbon preferred	110

ELECTRIC RAILWAYS.

(Special Correspondence.)

HIBBING, MINN.—The Northern Traction Company is planning the building of a line from Hibbing to Chisholm and Buhl. C.

SPOKANE, WASH.—The Spokane, Columbia & Western Railway Company has applied for a franchise to enter the city of Spokane. A.

VIRGINIA, MINN.—The Mesaba Rapid Transit Company is planning to connect Virginia, Biwabik, Aurora and McKinley by an electric railway. C.

SANTA BARBARA, CAL.—The Santa Barbara Consolidated Railroad Company has been granted a franchise for a street railway along Bath Street. A.

ST. PAUL, MINN.—The Great Northern Railway has ordered four electric locomotives to operate passenger and freight trains through the Cascade Tunnel. C.

ROBARD, KY.—The Panama Coal and Coke Company, of Robard, will build an electric tramway from Robard to the Green River, four miles distant.

LOS ANGELES, CAL.—Bids will be received February 9 for a franchise to operate an electric railway on Fifty-fourth and Hoover streets, Los Angeles. A.

DAVENPORT, IOWA—J. W. Crowley and others have applied at Springfield, Ill., for a charter for the Tri-City & Northeastern Interurban Railway Company. C.

DES MOINES, IOWA—Plans are being made to convert the Newton & Northwestern Railroad into an electric line and thus provide interurban service into Des Moines. C.

ROME, GA.—The Rome Railway and Light Company has authorized a new issue of $250,000 of bonds, contemplating extensions in Rome and also from Lindale to Boozeville.

CLE ELUM, WASH.—The Cle Elum-Roslyn Electric Railway and Power Company has been granted a franchise for its road and to generate electricity for commercial purposes. P.

BOISE, IDA.—Mr. Jellison, owner of a large marble quarry several miles from Snake River, will build an electric railway from the property to the river and ship the marble as it is quarried. A.

BARTLESVILLE, OKLA.—Contracts are being prepared to build an electric interurban railway out of Bartlesville along the grade of the old Jacob Bartles Railroad from Bartlesville to Ochelata, ten miles.

CHICAGO, ILL.—Directors of the Midlothian Country Club, of Chicago, have decided to electrify the club's railroad, known as the Midlothian & Blue Island Railroad. It is estimated that the cost will be $20,000.

NEW YORK, N. Y.—The intention of the New York, New Haven & Hartford Railroad Company, it is reported, is to absorb the Union Railroad, a trolley line operating in Westchester County, which is now in the hands of a receiver.

BUFFALO, N. Y.—The first through passenger car over the Buffalo & Lake Erie trolley line from Buffalo to Erie, Pa., has made the trip and new cars for the long-distance service have been ordered and are expected to be in use soon.

GRAND FORKS, N. D.—At the first annual meeting of the Grand Forks Street Railway Company the following officers were elected: R. B. Griffith, president; J. D. Bacon, vice-president; O. A. Webster, secretary, and D. H. Beecher, treasurer. C.

CHEHALIS, WASH.—W. J. Patterson, Theodore Hoss and A. Welch have been granted a thirty-five year franchise for an electric railway in Chehalis. Construction is to begin within six months, the road to be in operation within one year. A.

WILMINGTON, CAL.—Work has been begun by the Pacific Electric Railroad in the construction of its line between Wilmington and San Pedro. The franchise was granted nearly two years ago and the company has only two months in which to complete the line. A.

BIRMINGHAM, ALA.—It is reported that contracts will soon be let for the Birmingham & Shades Mountain Electric Railway, five miles long. G. T. Brazelton and others are interested. Ohl & Totten, 103 North Twentieth Street, Birmingham, are the engineers.

CITY OF MEXICO, MEXICO—The Tramways Company will begin at once the electrification of its Penon line which at present is being operated by mule cars. The plans of the Tramways Company have been approved by the Secretary of Communications. A.

STOCKTON, CAL.—Rights-of-way from Modesto to Riverbank have been secured by Morris L. Brackett, of New York, who has obtained similar concessions from Stockton to Modesto, for the San Joaquin Valley Electric Railway Company. That part of the proposed road between Stockton and Modesto is almost ready for construction work. A.

NEW YORK, N. Y.—The application has been granted for the New York & North Shore Traction Company to construct and operate a double-track street railway from the intersection of Broadway and the city line to the former villages of Bayside and Flushing.

NEW YORK, N. Y.—The Queensboro Bridge & Jamaica Railway Company has applied for permission to construct and operate a double-track street railway from the terminal at the Manhattan end of the Queensboro Bridge, over the bridge and its approaches to Union Hall Street, together with several spurs.

SAN FRANCISCO, CAL.—Former Directors Edward Chambers and H. K. Gregory, of the Northwestern Pacific Railroad Company, were succeeded by W. R. Scott and C. B. Seger at the annual meeting recently held in San Francisco. Secretary J. L. Wilcutt was succeeded by George L. King. The company operates electric as well as steam lines. A.

GRAND RAPIDS, MICH.—On petition of the New England Trust Company, of Boston, John P. Reynolds has been appointed receiver for the Manistee Light and Traction Company, of Manistee, Mich. The company operates electric-lighting, gas and street-railway systems at Manistee, and has $1,500,000 bonds outstanding, upon which the interest is in default.

KITTANNING, PA.—At a cost of about $300,000 the Clarion & East Brady Electric Railway Company proposes to build a trolley line from Clarion to East Brady, via Eligo and Rimersburg, a distance of twenty-five miles, and by connecting with a road projected between Butler and East Brady, make a complete trolley route of eighty-six miles from Pittsburg to Clarion.

SIOUX FALLS, S. D.—Interest in the Sioux Falls & Sioux City Electric Railway Company, which was organized two years ago, is being revived. The capital stock is $1,000,000, and the officers are as follows: O. H. Smith, president; Charles Fantle, vice-president; E. D. Morcom, secretary and treasurer; George W. Burnside, general manager, and F. C. Whitehouse, superintendent. C.

CORSICANA, TEX.—J. V. Watkins, of Corsicana, and A. M. Collins and W. A. Davis, of St. Louis, have planned to build an interurban electric railway from Dallas via Waxahachie to Corsicana, with a spur ten miles long from Waxahachie to Ennis and also from Corsicana to Palestine, Tex. The latter line would be sixty miles long, and the total distance from Dallas to Palestine 117 miles.

SPRINGFIELD, ILL.—The Secretary of State has issued a license to incorporate to the Chicago, Joliet & Pacific Railway Company. The principal office is in Chicago and the capital stock is $50,000. It is proposed to construct the road from Chicago southwesterly to Joliet, in Will County, thence westerly through the counties of Grundy, La Salle, Bureau, Henry and Mercer to Keithsburg.

HOBART, OKLA.—The Hobart Motor Railroad Company is reported to have reorganized and will soon build an electric railway. H. H. Hoover is president; C. Townsend Blake, vice-president; J. H. Montgomery, secretary; R. E. Nye, treasurer. W. T. Croslen of Chickasha, Okla., is also a director. All of the officials are local men with the exception of Mr. Blake, who resides in New York city.

RALEIGH, N. C.—A charter has been issued for the Goldsboro Traction Company for the construction and operation of a street-car system in and around Goldsboro to the limit of fifty miles in any direction out of the city. The capital is $150,000 authorized, and $45,000 subscribed by A. T. Oliver, J. H. Trent, S. L. Blackburn and J. S. Oliver. The active management is in the hands of A. T. Oliver.

RACINE, WIS.—Manager John I. Beggs, of the Milwaukee Electric Railway and Light Company, has given out the information that the company would have the new line from Waterford to Burlington open and ready for traffic early in the spring and that it could then be extended down to Lake Geneva. With reference to the line from Racine west he intimated that a branch would eventually be built to tap the main line at Burlington.

LOS ANGELES, CAL.—Incorporation papers have been filed for the Pasadena Rapid Transit Company, which has been formulating plans for building a new electric line between Los Angeles and Pasadena over the right-of-way of the old cycleway. The company is capitalized for $3,000,000 and its incorporators are George H. Hayes, of Los Angeles, and E. J. Sheehan, W. H. Smith, Don C. Porter, E. H. May and Horace M. Dobbins, of Pasadena.

WHITE PLAINS, N. Y.—Justice Joseph Morschauer of the Supreme Court has appointed J. Addison Young of New Rochelle permanent receiver of the bankrupt Tarrytown, White Plains & Mamaroneck Railroad Company, with a bond of $20,000. Mr. Young has been acting as temporary receiver for some time. The company has been losing money daily, and recently defaulted in the payment of interest on a $300,000 mortgage held by the Knickerbocker Trust Company, which will begin immediate foreclosure proceedings.

INDUSTRIAL ITEMS.

THE ECONOMICAL ELECTRIC LAMP COMPANY, New York, N. Y., has removed its office and warehouse to 25 West Broadway.

THE THOMAS H. DALLETT COMPANY, York and Twenty-third Streets, Philadelphia, Pa., describes its line of steam-driven air-compressors in catalogue No. 100, recently issued.

THE H. W. JOHNS-MANVILLE COMPANY, 100 William Street, New York, N. Y., has prepared a handsomely-printed booklet on the subject of pipe and boiler insulation, describing the applications of asbestos, magnesia and other coverings.

THE AMERICAN STEAM GAUGE AND VALVE MANUFACTURING COMPANY, whose southern branch office for several years has been located in the Equitable Building, Atlanta, Ga., has removed this office to 524-525 Candler Building, in the same city.

THE ECH DYNAMO AND MOTOR COMPANY, Belleville, N. J., has arranged its new bulletin, No. 47, as a sectional catalogue and date book on the subject of motor-generators, giving details of manufacture and construction, dimensions and prices of these machines.

WICKES BROTHERS, Saginaw, Mich., have prepared their monthly stock list of boilers, engines, dynamos, motors and machinery which comprise the extensive and varied stock at their sales warehouses at Saginaw, Pittsburg, Pa., New York city and Jersey City, N. J.

THE INDIANA RUBBER AND INSULATED WIRE COMPANY, of Jonesboro, Ind., maker of Paranite and Peerless rubber-covered wires and cables, has prepared a handsome wall calendar, sixteen by twenty-four inches, that it will send to those interested in its products.

THE CHAIN BELT COMPANY, Milwaukee, Wis., manufacturer of the Chain Belt concrete mixer, has adopted its regular line of machines to be driven by electric motors placed on the trucks, and recommends this convenient arrangement as ideal, where the necessary current can be obtained.

MACGOVERN, ARCHER & COMPANY, 114-118 Liberty Street, New York city, places before users of electrical and steam machinery its January stock list of second-hand apparatus in its warehouses at Jersey City, ready for immediate shipment. The material listed includes powerhouse equipment, cars, etc.

THE METROPOLITAN ELECTRICAL SUPPLY COMPANY, Chicago, is sending circulars to its customers describing the new Superior electric flat-iron, which it is placing on the market. This iron is said to have many points of advantage and is sold at a lower price than others, which the company also handles.

THE CROUSE-HINDS COMPANY, Syracuse, N. Y., has issued a complete bulletin, No. 100, illustrating and describing the large line of condulet fittings, which are made in almost every conceivable type and for a great variety of purposes. The catalogue contains dimensions, specifications and list prices of the articles described.

THE NEW DEPARTURE MANUFACTURING COMPANY, Bristol, Conn., has prepared a handsome bulletin on the subject of its New Departure "two-in-one" annular ball bearing, a novel mechanical principle developed by Albert F. Rockwell, which comprises a self-contained radial and thrust bearing that is equally efficient in all directions.

THE NERNST LAMP COMPANY, Pittsburg, Pa., in its little monthly magazine, "Lux," for January shows, as usual, quite a number of buildings in which the Nernst lamp is extensively installed. It also contains extracts from contemporary articles showing an appreciation of the work done by this type of lamp in establishing the science and art of illuminating engineering.

THE MONARCH VIBRATOR COMPANY, Security Building, Chicago, Ill., has published a twenty-four-page catalogue of Monarch electric vibrators and the many ailments for which their use is recommended. Detailed directions are given for applying the vibrator for special treatments. The Monarch vibrators are provided with motors adapted for dry battery or electric-light connection and in the latter case for use with direct or alternating current.

WESTERN ELECTRIC COMPANY bulletin No. 5910-9, devoted to electrical equipment for central stations, describes the lines of alternating and direct-current generators, built by this company, adapted to be driven by steam reciprocating or turbine engines, gas engines and waterwheels. Western Electric switchboard and lighting equipment is also illustrated in the several half-tone reproductions of actual plants and installations, included in the bulletin.

THE CENTRAL ELECTRIC COMPANY, Chicago, is distributing an attractive and interesting twenty-page illustrated booklet on Opalux shades and reflectors. The circular contains descriptive matter relating to the manufacture, application and results secured by the use of Opalux shades. Curves from tests by the Electrical Testing Laboratories, New York city, should be of interest to lamp users. It is said that Opalux shades are particularly adapted to the new high-efficiency units.

THE BLAKE SIGNAL AND MANUFACTURING COMPANY, Boston, Mass., reports the following quotations from two of many similar letters recently received: "In regard to the sample of Blake tube flux received from you, will say that I have never used anything for soldering that equals it;" and from a telephone company, "We find the Blake insulated staples, compressed cleats and tube flux the best for their respective purposes that we have ever used and are buying them regularly from our dealers."

THE DEARBORN DRUG AND CHEMICAL WORKS reports that the general business of the company for the last six months of 1908 was larger than for any other six months in its history, indicating the quick return of prosperous business conditions. The percentage of increase the past few months, and especially for January, in the eastern department of the company, is particularly gratifying. In this department the company has a most effective organization which is an assurance of the high-grade manner in which its affairs will continue to be handled.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., in a folder (No. 3744), just issued, the company describes transformers for use in connection with moving-picture-machine arc lamps. This transformer is known as "The G. E. Economy-Arc," and the advantages claimed for it are reduction of light mills, simplicity of operation and safety. The saving in power insured by the use of a transformer instead of a rheostat varies from sixty-five to ninety per cent, depending upon the voltage of the circuit. The construction of this transformer is very substantial and embodies all of the distinctive features of the transformers manufactured by this company.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has placed on the market a portable polyphase wattmeter which gives in a single indication the total power consumed in two-phase or three-phase circuits, or the power consumed in a single-phase. The instrument has the same accuracy on an unbalanced as on a balanced circuit. The Wagner line of switchboard and portable instruments is one of the most complete that the American market affords, including ammeters, voltmeters, wattmeters, power-factor indicators, frequency meters, ground detectors and synchronism indicators, together with current and potential transformers for all capacities, voltages and frequencies and any character of service.

THE HARVARD ELECTRIC COMPANY, 66 West Van Buren Street, Chicago, and 136 Liberty Street, New York city, reports that the new Harvard patent galvanized channel steel bracket is meeting with much success since it was placed on the market a few months ago. The firm has sent out a number of brackets on approval and has received orders and testimonials relative to their serviceable qualities. This line includes steel construction material for telephone, telegraph, electric light and power transmission work in the way of brackets, foot and corner straps, pole fixtures, construction tools, etc. Allen L. Haase, for years actively identified with the steel bracket industry, is now sales manager of the company and is paying particular attention toward developing the bracket end of the Harvard business.

THE BUFFALO FORGE COMPANY, of Buffalo, N. Y., has issued catalogue No. 197 devoted to the Buffalo fan system of heating and ventilation. The book of 144 pages is an excellent example of the printer's and engraver's arts. In Part I the application of the Buffalo system to public buildings is described and illustrated by many typical installations in schools, hospitals, court houses, churches, etc. Part II similarly describes installations in various industrial plants, workshops, mills, etc. In the third part the apparatus is described in detail; it provides indirect heating and direct ventilation by forcing carefully-tempered air into the rooms, the air being washed, heated and humidified to any degree desired and maintained to that standard automatically. The fans are either engine or motor driven. The last fifty pages (Part IV) are filled with data on heating and ventilation that are of much value to the engineer concerned with these problems.

DATES AHEAD.

Chicago Electrical Show. Coliseum, Chicago, Ill., January 16-30, 1909.

Indiana Electric Light Association. Indianapolis, Ind., January 26.

American Association of Electric Motor Manufacturers. Next meeting, Hotel Schenley, Pittsburg, Pa., January 26-28.

Minnesota Electrical Association. Second annual meeting, Nicollet Hotel, Minneapolis, Minn., March 18-19, 1909.

Omaha Electrical Show. Omaha Auditorium, Omaha, Neb., May 6-15.

Worcester Mechanical and Electrical Exposition. Mechanics Hall, Worcester, Mass., March 27-April 3.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) January 12, 1909.

909,136. DYNAMO-ELECTRIC MACHINE. Bernard A. Behrend, Norwood, Ohio, assignor to Allis-Chalmers Company, and the Bullock Electric Manufacturing Company. Filed November 27, 1905. The revolving field of an alternator has ventilating fan segments secured to its sides.

909,146. RELAY. John P. Buchanan and Frederick B. Wiegand, Cleveland, Ohio. Filed July 18, 1907. A magnet adapted to positively actuate the armature of the relay is controlled by a slight initial movement of the armature.

909,158. BLOCK-SIGNAL SYSTEM. Fred B. Corey, Schenectady, N. Y., assignor to General Electric Company. Filed March 30, 1908. A motor moves the signal arm and thereby controls contacts governing the signal next in the rear, the contacts being short-circuited when the motor is in operation.

909,165. PORTABLE FUSE AND FUSE-BLOCK. George A Drucker, New York, N. Y. Filed July 14, 1908. A trough of non-combustible material closed at the ends is provided with a fine wire terminated in fastenings which depend from the trough.

909,192. ELECTRIC ALARM BELL. Nikolaus Kessler, Ragusa, Austria-Hungary. Filed May 27, 1907. Avoids accidental ringing of the bell by providing two spring arms restraining the hammer, the armature being on the active ends of the arms.

909,193. ALTERNATING-CURRENT MOTOR. Marius C. A. Latour, Paris, France, assignor to General Electric Company. Filed August 17, 1907. A commutator-type motor has a commutating coil, and connections therefor, including two sources of opposing voltages, the smaller increasing with speed.

909,197. DYNAMO-ELECTRIC MACHINE. Matthew W. W. Mackie, Ealing, England. Filed July 24, 1907. The voltage of a shunt dynamo is maintained practically constant by a demagnetizing winding and a storage battery opposing the flow of current therethrough.

909,198. COMBINED TELEGRAPH RELAY AND SOUNDER. Alfred J. Meyer, Milwaukee, Wis. Filed September 19, 1907. Combined with the relay is a closed sounding drum, a sounding horn connected with the periphery of the drum, a vibratory arm with contact bearings connected with the relay armature and adapted to alternately cause a vibratory movement of the drum heads.

909,201. ELECTRIC CONTROLLING AND SIGNALING SYSTEM FOR RAILWAYS. Herbert E. McDonnell, Leominster, Mass. Filed August 7, 1906. A third-rail road has cams located at the block terminals, which engage arms depending from the car that can reverse an electromagnetic controlling means.

909,216. MEANS FOR STARTING DYNAMO-ELECTRIC MACHINES. William D. Pomeroy, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. Filed May 17, 1906. A synchronous motor has a notched wheel at the end of its shaft that can be engaged by a compressed-air piston to overcome static friction, an auxiliary motor then bringing the machine up to speed.

909,247. TROLLEY-POLE FASTENING. Oliver L. Spry, Des Moines, Ia. Filed September 16, 1907. A standard is formed with a socket to receive a tubular pole with a lengthwise slot, engaging a lug in the socket, and held by a pin.

909,253. COIN-OPERATING MECHANISM. Ernest F. Symonds and George W. Brann, Salem, Mass., assignors to Standard Machines Company, Boston, Mass. Filed November 2, 1906. Comprises a circuit-closer engaged by a latch and controlling the operation of the motor.

909,264. SPARKING IGNITER. Luther H. Wattles, Providence, R. I., assignor of one-half to Matie C. Messler, Pawtucket, R. I. Filed May 29, 1908. Compression of the engine charge gives a direct throw to the armature of the generator.

909,309. APPARATUS FOR GENERATING OZONE. Wilhelm Kölle, Stuttgart, Germany, assignor of one-third to William Elworthy, Sunnyside Wellington, Somerset, England, and one-third to Christian Held, Stuttgart, Germany. Filed February 12, 1908. A number of concentrically arranged dielectric tubes, having conductors between them, are arranged to connect in series different chambers of a casing through which air to be ozonized is passed.

909,311. AUTOMATIC SPRINKLER ALARM AND INDICATOR. Frank W. Milliken, Auburn, Me., assignor of one-half to Cheney C. Brown, Auburn, Me. Filed December 30, 1907. Opening the valve between the main pipe and the sprinkler system closes an electric bell and an annunciator circuit.

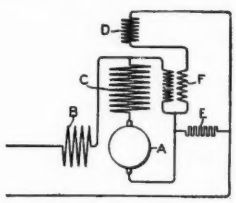
909,326. ELECTRIC-LAMP RECEPTACLE. George L. Patterson and James B. Farrell, New York, N. Y., assignors to Alice C. Patterson, New York, N. Y. Filed August 10, 1907. Renewed September 11, 1908. An insulating base carries a metallic lamp socket and terminals protected by dams.

909,335. THIRD-RAIL ANCHORAGE. William B. Potter, Schenectady, N. Y., assignor to General Electric Company. Filed September 7, 1907. Comprises clamps secured to the rail on opposite sides of a supporting tie, and bolts and strain insulators for connecting the clamps and tie.

909,356. TELEPHONE-TRANSMITTER ATTACHMENT. John S. Wincrantz, Pittsburg, Pa. Filed August 12, 1908. An extension connected between the mouthpiece and transmitter casing has a lever projecting from it, and arranged to force a non-vibrating member into engagement with the diaphragm to prevent the latter from transmitting sound waves.

909,367. POTENTIAL STARTER ATTACHMENT. Herbert W. Cheney, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. Filed September 29, 1906. Combined with a controller handle and a rotatable drum is a spring-pressed pawl and a fixed notched plate co-operating therewith to permit rotation of the drum in one direction from all positions, and to prevent it in the other direction from certain positions.

909,382 and 909,383. ELECTRICAL-IMPULSE-TRANSMITTING DEVICE. John Erickson, Chicago, Ill., assignor to First Trust and Savings Bank, trustee, Chicago, Ill. Filed August 20, 1906. Latter application renewed October 14, 1908. A rotatable calling dial for operating an automatic telephone is provided with a retarding device by which its backward rotation is resisted only when an attempt is made to force it faster than normally. In the latter patent the dial is locked against back rotation as soon as the limit stop is engaged by the calling subscriber's finger.



909,193.—ALTERNATING-CURRENT COMMUTATOR MOTOR.

909,403. SWITCHING DEVICE FOR PARTY-LINE EXCHANGES. William Hagstrom, Lindsborg, Kan., assignor of one-fourth to John Anderson and one-fourth to Clarence A. Anderson, Salina, Kan. Filed June 11, 1906. A magnet is arranged to move its armature in either of two directions, according to the direction of the current, movement of the armature in one direction advancing the switch step-by-step.

909,405. CASING FOR LIGHT-FIXTURE STEMS. Philip J. Handel, Meriden, Conn. Filed March 9, 1908. A chain drop fixture has each link provided with a hub at each end for a passage of the stem.

909,414. TELEGRAPHONE APPARATUS. Ejnar A. Hytten, Copenhagen, Denmark, assignor to American Telegraphone Company. Filed December 31, 1907. Consists of a continuously movable wire, a pair of magnets with movable cores and springs for impelling the cores into contact with the wire.

909,417. ELECTRIC SELF-WINDING CLOCK. Henry O. Jackson and Herman C. Vizents, Chicago, Ill., assignors to Tom McNaughton, London, England. Filed April 24, 1908. A swinging armature on an electromagnet operates a circuit-closing ratchet and means connected with the spring to wind it.

909,418. ELECTRIC SECONDARY CLOCK. Henry O. Jackson and Herman C. Vizents, Chicago, Ill., assignors to Tom McNaughton, London, England. Filed June 10, 1908. At each pole of an electromagnet is an armature which actuates a worm wheel moving the hand shaft.

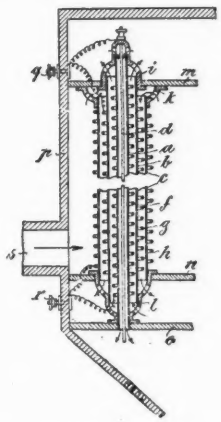
909,421. TELAUTOGRAPH. Charles F. Jenkins, Washington, D. C. Filed February 7, 1908. In combination with a transmitting instrument having electric distributing brushes at-

tached to a writing stylus is a reproducing instrument for a number of stylus-actuating motors.

909,428. ELECTRODE OR PENCIL FOR ARC LIGHTS. Isador Ladoff, Cleveland, Ohio, assignor of thirty one-hundredths to Philip C. Peck, New York, N. Y. Filed May 27, 1908. A luminous arc lamp has a positive electrode composed of graphite surrounding a core of iron and a negative electrode composed of ferric and titanic material.

909,430. RACK-RAIL AND TRACTION LOCOMOTIVE. Nils D. Levin, Chicago, Ill., assignor to Goodman Manufacturing Company, Chicago, Ill. Filed January 28, 1907. Comprises a motor driving two axles through sprocket wheels connected with the motor by clutches.

909,433. APPLIANCE FOR ELEVATORS AND OTHER MOVABLE OBJECTS AND BODIES. Adam Lüngen, New York, N. Y. Filed January 30, 1908. Consists of a door-operated circuit-closing device and an alarm arrangement to maintain the circuit complete after a magnetically-displaced means has returned to a normal position.



909,309.—OZONIZING APPARATUS.

909,438. INCANDESCENT LAMP. Matthew M. Merritt, Middleton, Mass., assignor to National Electric Lamp Company, Cleveland, Ohio. Filed February 24, 1906. A non-renewable lamp is provided with a guard for the end of a leading-in wire, which guard is independent of the filament fastening.

909,448. CABLE-HANGER. Charles L. Peirce, Jr., Chicago, Ill., assignor to the W. G. Nagel Electric Company, Toledo, Ohio. Filed May 31, 1905. A hook is bent to straddle a messenger cable and to form end fastenings for a cord passing around the lead-covered cable.

909,451. GLASS-SEVERING TOOL. Lonnie J. Pierce, Pittsburg, Pa. Filed May 20, 1908. Comprises two pivotally connected arms carrying terminals and a wire extending between the terminals, which is adapted to be heated by the passage of the current, a reel and spring keeping the wire taut.

909,458. INSULATED RAIL-JOINT. Edwards F. Schermerhorn, Brooklyn, N. Y., assignor to the Rail Joint Company, New York, N. Y. Filed April 23, 1908. Has sectional side insulating sheets, consisting of separate sections above and below the line of bolts.

909,481. TERMINAL-CONNECTOR. William C. Tregoning, Hackensack, N. J., assignor to the Tregoning Electric Manufacturing Company, Cleveland, Ohio. Filed October 22, 1906. The connector is looped somewhat like a safety-pin, but the free ends of the arms have symmetrical circular loops to pass around a binding post.

909,483. APPARATUS FOR THE MAGNETIC IGNITION IN EXPLOSION-MOTORS. Gustav A. Unterberg, Karlsruhe-Mühlberg, Germany. Filed January 31, 1906. The armature shaft has a coupling which can be temporarily stopped by a ball-and-slot arrangement.

909,485. SELF-WINDING CLOCK. Cleaver W. Wagner, Danville, Pa. Filed April 30, 1908. An electromagnet operates a rock shaft and causes two arms to engage for closing and opening the circuit.

909,503. CLOCK SYSTEM. Ernest E. Yaxley, Chicago, Ill., assignor to Monarch Telephone Manufacturing Company, Chicago, Ill. Filed October 26, 1908. A master clock with electromagnets and relays governs the secondary clocks electrically.

909,505. MUSIC-LEAF TURNER. Alfred T. Ziegler, Allegheny, Pa. Filed September 2, 1908. A switch actuated by the pedals controls the operation of a motor that moves the leaf-carrying arms.

909,507. PRISM FOR ELECTRIC LAMPS. Justus C. Zubli, Seattle, Wash. Filed November 5, 1907. A prism is rotatively mounted in front of the bulb of the lamp so that it can swing with respect to the latter.

909,511. QUADRUPLEX TELEGRAPH SYSTEM. Casper J. App, Lynchburg, Va. Filed September 23, 1907. Contains a pole changer sending to the line currents of different potential and direction.

909,539. CARRIAGE-RETURN MECHANISM FOR TYPEWRITERS. Elmer E. Burlingame, San Francisco, Cal., assignor to Burlingame Telegraphing Typewriter Company. Filed May 11, 1908. An electric motor is adapted to return the carriage under the control of an electromagnet and key.

909,551. SIGNAL APPARATUS. Clyde J. Coleman, Rockaway, N. J., assignor to the Hall Signal Company. Original applications filed July 8, 1901, and May 7, 1902. Divided and this application filed October 7, 1903. A signal arm is moved to safety position by action of a liquefied gas under the control of a signal circuit.

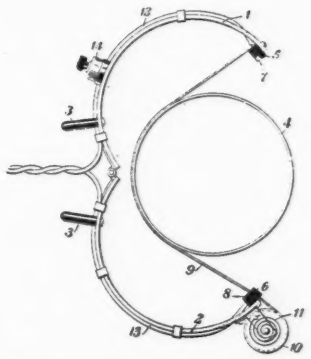
909,564. ELECTRIC FUSE. Louis W. Downes, Providence, R. I., assignor to D. & W. Fuse Co., Providence, R. I. Filed December 15, 1903. A plug fuse has a main fuse wire enclosed by the casing, and an indicator fuse wire in parallel with the main fuse.

909,566. TELEPHONE-TRANSMITTER. Joseph B. Edwards, Chicago, Ill., assignor to Kellogg Switchboard & Supply Company, Chicago, Ill. Filed May 5, 1905. A granule-containing chamber has a flexible diaphragm forming its rear wall and resilient means supporting the chamber, its vibration being adapted to agitate the granules to prevent packing.

909,569. TROLLEY-WIRE SUPPORT OR HANGER. Charles G. Ette, St. Louis, Mo., assignor to Ette Investment Company, St. Louis, Mo. Filed May 4, 1908. A one-piece inverted cup-shaped member has a shank projecting into and insulated from it, which is provided with clamping jaws for the trolley wire.

909,572. SECONDARY BATTERY. Louis H. Flanders, Wilkinsburg, Pa., assignor to the Westinghouse Machine Company. Filed April 15, 1905. A storage-battery separator consists of two perforated hard rubber sheets lying against the plate and having oblique ribs on their outer faces that serve at the bottom as lugs for holding the sheets to the plate.

909,573. DYNAMO DRIVE FOR CAR TRUCKS. Ethelbert T. Ford, St. Louis, Mo. Filed July 29, 1907. The method of mounting a dynamo in an axle car-lighting system is described.



909,451.—ELECTRIC GLASS CUTTER.

909,584. TROLLEY. Edwin H. Green, Emeryville, Cal. Filed September 13, 1907. Relates to details of the yoke construction.

909,594. SPARK COIL. John O. Heinze, Jr., Lowell, Mass. Filed June 3, 1908. An armature spring has means to limit its extreme movement in order to limit the primary current to a predetermined maximum.

909,595. SCREW-PRESS TO FORM INSULATORS. Ralph G. Hemingray and Charles Hawk, Muncie, Ind., assignors to Hemingray Glass Company, Muncie, Ind. Filed August 9, 1907. In combination with the plunger is a supporting member adapted to release the screws in succession one at a time and a delivery member adapted to deliver to the plunger a fresh screw at each operation of the plunger.

909,627. THERAPEUTIC LAMP. Edith W. Locke, Chicago, Ill.

Filed September 16, 1908. Consists of an incandescent lamp and a hood secured to its cap.

909,631. ELECTRICAL DRIVING MECHANISM. Gustave C. Marx, Elizabeth, N. J., assignor to Diehl Manufacturing Company. Filed April 23, 1906. Comprises a motor and friction clutch.

909,651. SELECTIVE ELECTRIC SIGNALING. Arthur H. Nicholson, Wendover, England. Filed February 20, 1908. Consists of a polarized relay having a single contact normally open and a doubly-wound polarized relay with a pair of contacts in series with the first, but normally closed.

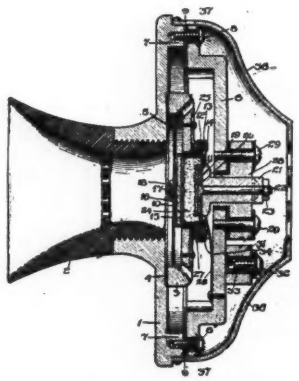
909,666 and 909,667. PROCESS OF OBTAINING NICKEL FROM SILICIOUS ORES. Edgar F. Price, Niagara Falls, N. Y., assignor to Central Trust Company, of New York, trustee. Filed July 29, 1907. The process of producing ferro-nickel consists of smelting the charge containing the ore of nickel and iron by passing a current through it acting as a resistance conductor.

909,673. BATTERY PLATE. George B. Rinehart, Ashland, Wis. Filed February 4, 1908. A battery grid comprises a rim provided with front and back horizontal bars spaced apart and vertically-disposed bars between the front and back bars.

909,691. HANGER FOR TROLLEY WIRES. Herman Schütte, Wheeling, W. Va. Filed September 12, 1907. A central socket has elastic shanks and longitudinal jaws extending therefrom, with means of locking the jaws to the trolley arm.

909,702. TELEPHONE TRANSMITTER. Sheldon A. Stienbarger and Ralph L. Stienbarger, Augusta, Ill. Filed July 16, 1907. Has an auxiliary diaphragm combined with multiple cells for the carbon granules.

909,716. BUTCHER'S SAW. Tony A. Tubbs, Treadwell, Alaska. Filed February 29, 1908. An electric motor runs on a suspended track and drives the saw by means of a flexible shaft.



909,566.—TELEPHONE TRANSMITTER.

909,732. ELECTRIC SECONDARY CLOCK. Herman C. Vizents, Chicago, Ill., assignor to Tom McNaughton, London, England. Filed September 21, 1908. A modification of No. 909,408.

909,742. SWITCH. Ralph W. Borchert, St. Louis, Mo. Filed December 16, 1907. Relates to details of a rotary snap switch.

909,795. PROCESS OF REDUCING ORES. John Herman, Lincoln, Neb. Original application filed September 15, 1905. Patent No. 831,160, dated September 18, 1906. Divided and this application filed March 14, 1906. Consists of reducing copper ores by means of hot reducing gases, then treating the material with a chloride solution to extract the copper, and electrolyzing the resultant solution.

909,811. PROCESS FOR EXHAUSTING LAMPS. Matthew M. Merritt, Middleton, Mass., assignor to Boston Incandescent Lamp Company, Danvers, Mass. Filed January 27, 1905. Consists in inserting a volatile chemical within the bulb, exhausting with the pump to the required degree, raising the filament to incandescence and partially volatilizing the chemical while still connected with the pump, and finally sealing off the bulb.

909,812. INCANDESCENT LAMP. Matthew M. Merritt, Middleton, Mass., assignor to National Electric Lamp Company, Cleveland, Ohio. Filed February 24, 1906. A non-renewable lamp has means operating to cause breakage of a leading-in wire on an attempted renewal of the lamp.

909,813. BATTERY-DISCHARGE REGULATOR. Edward J. Murphy, Brooklyn, N. Y. Filed June 9, 1908. Comprises a circuit-breaker in the working circuit and an electromagnet in a second circuit controlling this circuit-breaker.

909,814. ELECTRIC TRAP FOR RATS, ETC. John T. Norris, Troy, N. C., assignor of one-half to Christopher C. Wade, Troy, N. C. Filed September 24, 1908. Consists of a series of conducting plates separated from each other and insulated from the base, alternate plates being connected with opposite terminals of the circuit.

909,818. THERMO-ELECTRIC ALARM. John E. Paul and James M. Stewart, Denver, Colo., assignors of one-third to George W. Dolezal, Denver, Colo. Filed November 30, 1906. Renewed October 8, 1908. A sealed fluid container is provided with a flexible diaphragm adapted to be actuated by the expansion and contraction of the fluid to close one circuit or to break it and close another circuit.

909,831. PROCESS FOR PREPARING PRINTING PLATES BY MEANS OF ELECTROLYTIC ETCHING. Hans Strecker-Aufermann, Munich, Germany. Filed December 13, 1906. Consists in coating the metal plate on one side with a layer of chrome colloidal material, copying an image into the layer by exposing it to light behind a suitable phototype, and using the prepared plate as an anode in an electrolytic bath which causes a swelling of the colloidal layer.

909,834. BRUSH HOLDER FOR DYNAMO-ELECTRIC MACHINES. Miles Walker, Hale, England, assignor to Westinghouse Electric and Manufacturing Company, East Pittsburg, Pa. Filed March 23, 1908. Comprises a frame for an adjustable guide projection producing a recess at one end of the frame, brush blocks mounted in the recess and a V-shaped spring having arms that engage the blocks.

PATENTS THAT HAVE EXPIRED.

Following is a list of electrical patents (issued by the United States Patent Office) that expired January 19, 1909:

467,169. FILAMENT FOR ELECTRIC LAMPS. P. Hickley, Evanston, Ill.

467,192. ELECTRIC ELEVATOR. N. P. Otis and R. C. Smith, Yonkers, N. Y.

467,233. PROCESS OF ELECTRIC METAL WORKING. H. Lemp, Lynn, and W. S. Woody, Chelsea, Mass.

467,239. BATTERY ZINC. C. B. Schoenmehl, Waterbury, Conn.

467,240. ELECTRIC BATTERY. C. B. Schoenmehl, Waterbury, Conn.

467,243. ELECTROMAGNETIC BRAKE. H. E. Walter, London, England.

467,250. TROLLEY FOR ELECTRIC RAILWAYS. E. R. Harding, Winthrop, Mass.

467,255. LIQUID RHEOSTAT. H. Lemp, Lynn, Mass.

467,259. ELECTRIC RAILWAY BRAKE. E. Verstrarte, St. Louis, Mo.

467,270. INCANDESCENT ELECTRIC LAMP. C. H. Wilkins, Chicago, Ill.

467,276. INCANDESCENT ELECTRIC LAMP. J. L. Curtiss, Grand Rapids, Mich.

467,318. COMMUTATOR FOR DYNAMO-ELECTRIC MACHINES AND MOTORS. E. Thomson, Swampscott, Mass.

467,338. RHEOSTAT. C. Willms, Baltimore, Md.

467,350. ELECTROLYTICAL PLANT. O. Stalmann, Anaconda, Mont.

467,358. REGULATOR FOR ELECTRIC GENERATORS. E. W. Rice, Jr., Lynn, Mass.

467,372. GALVANIC BATTERY. F. Gendron, Bordeaux, France.

467,448. ELECTRIC RAILWAY. C. J. Van Depoele, Chicago, Ill.

467,449. CONTROLLING APPARATUS FOR ELECTRIC MOTORS. C. J. Van Depoele, Lynn, Mass.

467,450. ELECTROMAGNETIC RECIPROCATING PUMPING ENGINE. C. J. Van Depoele, Lynn, Mass.

467,451. RECIPROCATING ELECTRIC ENGINE. C. J. Van Depoele, Lynn, Mass.

467,465. ELECTRIC LOCK. F. S. Holmes, Boston, Mass.

467,478. ELECTRIC RAILWAY SIGNAL. Wm. F. Z. Desant, New York, N. Y.

467,484. ELECTROLYTICAL PROCESS AND APPARATUS FOR CARRYING OUT SAID PROCESS. O. Stallmann, Anaconda, Mont.